REVIEW OF THE NATIONAL ACADEMY OF SCIENCES' REPORT "INVESTING IN RESEARCH"

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON DEPARTMENT OPERATIONS, RESEARCH, AND FOREIGN AGRICULTURE

OF THE

COMMITTEE ON AGRICULTURE
HOUSE OF REPRESENTATIVES

AND THE

SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION

OF THE

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REVIEW OF THE NATIONAL ACADEMY OF SCIENCES' REPORT "INVESTING IN RESEARCH"

TUESDAY, OCTOBER 17, 1989

HOUSE OF REPRESENTATIVES; SUBCOMMITTEE ON DEPARTMENT OPERATIONS, RESEARCH, AND FOREIGN AGRICULTURE; COMMITTEE ON AGRICULTURE; JOINT WITH THE U.S. SENATE; SUBCOMMITTEE ON AGRICULTURAL RESEARCH AND GENERAL LEGISLATION; COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY,

Washington, DC.

The subcommittees met, pursuant to notice, at 3:05 p.m., in room 1300, Longworth House Office Building, Hon. George E. Brown, Jr. (chairman of the Subcommittee on Department Operations, Research, and Foreign Agriculture) presiding.

Present from the Subcommittee on Department Operations, Research, and Foreign Agriculture: Representatives Brown, Stenholm, Olin, Volkmer, Jontz, Roberts, and Walsh.

Present from the Subcommittee on Agricultural Research and General Legislation: Senator Daschle.

Staff present from the Committee on Agriculture: John E. Hogan, minority counsel; Alice Devine, minority associate counsel; Glenda L. Temple, clerk; William A. Stiles, Jr., Anita R. Brown, and John J. Aguirre.

Staff present from the Committee on Agriculture, Nutrition, and Forestry: Mary Byrne, hearing clerk, and Kathleen Merrigan, professonal staff member.

OPENING STATEMENT OF HON. GEORGE E. BROWN, JR., A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. BROWN. The subcommittees will come to order.

Today, we are joining our Senate counterparts to examine agricultural research issues. Last year, we had a joint hearing on the general issue of agricultural research needs, and today we are here to examine a recent report from the National Academy of Sciences' National Research Council, entitled "Investing in Research."

This study makes a clear case for the need to expand our public funding efforts directed at agricultural research. It comes to the conclusion that a major reinvestment is needed at the Federal level, one which has been set at $500 million.

It may be seen by some as bad timing for an initiative of this magnitude to be raised during a period when we are struggling to deal with the budget deficit. To me, it seems that the situation has

reached such a crisis that, budget problems or not, the issue needs to be raised.

The initiative proposed by the academy's report is not out of line with what President Reagan proposed for the National Science Foundation or for our civilian space program. The initiative seems to have caught the imagination of a number of leaders in the agricultural sector and elsewhere. I think that we need to begin examining the state of our public agricultural research efforts, starting with this comprehensive review produced by the academy.

Today, we will be hearing from representatives of the Board on Agriculture of the National Research Council, and from agricultural producers. It is my hope that in coming months we can continue our review of agricultural research, extension, and teaching programs as we move toward consideration of the 1990 farm bill. I look forward to hearing from the witnesses and expect that their guidance will prove useful in the months ahead.

I will now call on my colleague, Mr. Roberts, for any opening statement he may have.

OPENING STATEMENT OF HON. PAT ROBERTS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF KANSAS

Mr. ROBERTS. Thank you, Mr. Chairman.

I would like to commend the chairmen of both subcommittees, Chairman Brown and Chairman Daschle, who will be arriving very soon. As we all recall, Tom Daschle is a former member of the House Ag Committee, and it will be good to welcome him back. He is now in the other body, which is the reason I am to the right of George Brown, which is rather unique in most cases.

This is the second joint hearing in a little over 1 year that we have held in regard to agricultural research. I would like to remind my colleagues and all present that, in the last session of Congress, both the Senate and the House passed agricultural research bills, but time did not allow us to overcome our differences and send the bill to the President. But we all know that work on the 1990 farm bill will entail many new substantial initiatives for ag research.

As a matter of fact, we policymakers in agriculture look to the ingenuity and the commitment and the persistence of our agricultural researchers to help cope with such highly volatile issues as ground water, endangered species, food safety and all the rest of the issues that we must deal with.

The needs of our society and much of the world are addressed by a highly sophisticated and capital-intensive food and fiber system that operates in this country, and we need to continue our commitment to increased productivity gains in the farm sector of the economy. Advances in productivity are necessary to offset the growing competitiveness of such exporting countries as Australia, Argentina, Brazil, and the European Community.

In addition to the economic benefits of a productive agricultural system and annual export contribution exceeding $35 billion, we must not forget the humanitarian commitment our farmers have made to a troubled and hungry world and will continue to make as long as needed.

Mr. Chairman, in 1980, the average income per-head in the poorest region of the world, in black Africa, was $560, and that is in 1980 dollars. Last year, it was $450. These numbers indicate a profoundly wretched and intolerable human condition.

A report by an ad hoc panel meeting, under the Office of International Affairs of the National Research Council, found that a doubling of food aid over present levels of about 10 metric tons per year would be necessary to meet projected market needs throughout the decade of the nineties. Not only that, but projected nutritional needs estimates are much higher, a quadrupling or more over present levels could be required by the year 2000. The report also warned that Asia may again become the most troubling food deficient area, because of an unfavorable population and land ratio.

This means the United States cannot indulge in a debate of aesthetics. I know we have severe budget problems, and they are real. But at the expense of our economic needs and our humanitarian commitments, we must move ahead in regard to ag research. The burden will be on our ag researchers to help us reconcile these conflicts.

Mr. Chairman, we are going to be holding hearings on a food safety bill this coming Thursday, and hopefully starting to mark that legislation up sometime before the session concludes.

It would be my hope that we could get some direction or some report language to address more research into natural toxins. We have heard a great deal about pesticide safety. We really do not know too much about the natural toxicity of natural carcinogens in the food supply and, quite frankly, that is where we get into real problems with food safety, of people actually becoming sick and losing their lives. So, in that particular area, I am very much interested in one of the major research goals or areas that has been recommended by the NAS report. I think it is No. 2, involving nutrition, food quality, and health, and we certainly need that commitment.

I thank the chairman again for simply holding the hearing.

Mr. Brown. I thank my distinguished colleague for his comments and I assure him that any focus that he wishes this subcommittee to take will be very seriously considered.

Any other members of the subcommittee desire to make an opening statement.

Mr. Jontz.

Mr. Jontz. Mr. Chairman, I do want to take half a minute to welcome all our witnesses, but in particular welcome Dean Thompson. Purdue University is a very fine research institution, of course, and I am looking forward to his testimony today.

Thank you, Mr. Chairman.

Mr. Brown. Well, we have to be prepared for every contingency here and that contingency is a vote over on the floor, so, rather than interrupting the witnesses after they get started, I am going to call for a short recess and ask the members to return as quickly as they can, and then we will call the first panel of witnesses.

The subcommittees will be in recess briefly.

[Recess taken.]

Mr. Brown. The subcommittees will reconvene.

We now have with us Senator Daschle, who is chairman of the corresponding subcommittee on the Senate side, and I will ask Senator Daschle if he has any opening statement he would like to make.

OPENING STATEMENT OF HON. THOMAS A. DASCHLE, A U.S. SENATOR FROM THE STATE OF SOUTH DAKOTA

Senator DASCHLE. Mr. Chairman, let me say, on behalf of the entire Senate Agriculture Committee, how pleased we are to have an opportunity to work jointly with you on this matter.

I do not know of anyone who has more of a preeminent reputation here in the Congress on agricultural research than do you, and so it is an honor for me to be back in this room, in particular, working with you on an issue of great mutual importance.

The Board on Agriculture of the National Academy of Sciences is proposing a new and significant change in research investment. While I acknowledge the need for reinvestment in our agricultural research system, I have several concerns about this new initiative and feel that we have an excellent panel of witnesses assembled to clarify some of these concerns.

We all have become familiar with the growing problems in our agricultural system. Both urban and rural residents are becoming increasingly concerned about microbiological contamination, pesticide residues, and the quality of our drinking water. Our farmers are producing an abundant supply of food, but consumers are not always satisfied with the nutritional quality of that food. The research system needs to focus on improving the nutritional quality of our food that is produced. Rural communities are suffering economically, and it will require the agricultural research system to develop systems which will sustain and revitalize these communities, as well as address our long-term basic research needs.

Maintaining agricultural productivity and competitiveness as the climate undergoes changes will also require a significant investment in research. My State has undergone 2 consecutive years of severe drought, and that disaster exemplifies the need for the research community to develop new systems that are adapted to environmental extremes.

We have traditionally looked to research for answers to our problems. However, agricultural research has tended to focus largely on producing more product, and not enough on encouraging the continued economic viability of our agricultural industry.

If this new initiative into agricultural research is to be a success and gather adequate support, it must not only focus on research that will result in higher yields, but focus, as well, on increasing the demand for agricultural products by developing new uses for those products.

We all agree that there is a need for agricultural research. It is time that the agricultural research system make new connections and conduct new areas of research, and this new focus will require more than just an increase in funds. New initiatives are needed to better manage the resources we currently have.

Along with increasing funding for the competitive grant system, we must evaluate the effectiveness of how the grants are awarded.

The Senate subcommittee, which I chair, has reviewed how funds are allocated to the research system. In those hearings, it has become clear to me that competitive grants are awarded to a select number of large, well-equipped research universities. Small land-grant universities are often overlooked in awarding these grants. The land-grant university in my State of South Dakota has received only five competitive grants in the entire history of USDA competitive grant programs.

One of the concerns that I have with this new initiative is that it may only allow for large, well-equipped universities to get additional research funding. This new program must provide parity in awarding research grants.

My final concern is that formula funding will bear the cost of increasing competitive grants. This funding system is too important to maintaining the infrastructure of the land grant university agricultural research system. If this initiative is to be successful, it will require a broad base of support. We have assembled a diverse group of individuals and look forward to hearing their views and concerns on this potential new investment in agricultural research this afternoon.

Thank you.

Mr. BROWN. Thank you very much, Senator. I am sure the witnesses will recognize the importance of the points that you have raised and will do their best to address them.

Mr. Walsh, do you have an opening statement?

Mr. WALSH. Thank you, Mr. Chairman, for recognizing me. I do not have an opening statement with me today, but I would like to ask unanimous consent to submit one for the record at some point in the near future.

Mr. BROWN. Without objection, it is so ordered.

Mr. WALSH. Thank you.

Mr. BROWN. We now have as our first panel Dr. Robert Thompson, who is dean of agriculture at Purdue, and also a Member of the Board of Agriculture of the National Research Council; and Dr. Robert Goodman, executive vice president for research and development at Calgene, likewise, as I understand it, a Member of the Board on Food and Agriculture of the National Research Council.

We are very pleased to have these two distinguished members of the Board which prepared this impressive study on research needs and we welcome them to the hearing this afternoon.

Before allowing Dr. Thompson to proceed, I have a request here, I think, from Ted Hullar, the Chairman of the Board, a distinguished dean at the University of California at Davis, and, without objection, I would like to enter his letter in the record, since he was invited to testify but was unable to be here.

[The letter of Mr. Hullar appears at the conclusion of the hearing.]

Mr. BROWN. Now, Dr. Thompson, we look forward to hearing from you.

STATEMENT OF ROBERT L. THOMPSON, DEAN OF AGRICULTURE, PURDUE UNIVERSITY, AND MEMBER, BOARD OF AGRICULTURE, NATIONAL RESEARCH COUNCIL

Mr. THOMPSON. Thank you very much, Mr. Chairman.

I am delighted to be here today to testify in support of the national agricultural, food, and environmental research initiative proposed by the Board on Agriculture.

The Board makes a bold proposal—for the Federal Government to increase its annual investments in research on agricultural, food, and environmental problems by $500 million. The decision to recommend an annual investment of this magnitude was not taken lightly.

We recognize the urgency of reducing the Federal budget deficit. Nevertheless, the Board concludes that our agricultural, food, and natural resource system is confronting a number of problems of such severity that we cannot afford to wait.

These problems include concerns about water quality, about the link between diet and health, about rural economic revitalization, development of new uses from commodities in surplus, international cost competitiveness; increasing value-added product exports. This is just a sample of the problems and challenges confronting the U.S. agricultural food and natural resources system.

Fortunately, breakthroughs in basic research in the biological sciences and engineering over the past two decades provide tremendous opportunities to draw upon science to solve these problems. Unfortunately, these breakthroughs in basic science and engineering have occurred at a time of stagnating or shrinking Federal investments in agricultural, food, and natural resources research.

Of particular concern to me is the fact that we as a country are now being out-invested in agricultural research by other countries. Relative to countries with which we compete in the world market, U.S. investments in the research on which much of our comparative advantage resides is declining.

While the core Federal and State appropriations maintain the basic research infrastructure, it is competitive research grants that make our scientists productive and focus their attention on high-priority research issues. Competitive grants attract the best minds in the country to address the priority problems of concern to the granting agency, whether those minds are in land grant universities, Federal laboratories, private universities or wherever.

Unfortunately, competitive grants for research on agricultural, food, and natural resources problems are inadequate to attract much attention from the Nation's best scientists. In fiscal year 1988, the USDA distributed $40 million in competitive grants, while the National Institutes of Health provided grants totaling $6.4 billion. The average USDA grant of $50,000 runs for 2 years, while NIH grants average $154,900 per year for 3 to 5 years.

Our scientists find that USDA grants are too small to get the job done, involve too much starting and stopping, and rarely last long enough to productively involve graduate students in the research.

The objective of this initiative is to fix the problems with USDA's competitive grants program, in order to attract some of the best

minds in the country to help solve the pressing problems of the agricultural, food, and natural resources system.

Four different types of grants are envisioned: First, principal investigator grants have a proven track record in the highly successful competitive grants programs of NSF and NIH. However, recognizing that many of today's problems in agricultural, food, and natural resources are too complex for a lone scientist working in one discipline, the second category proposed is for multidisciplinary research grants.

While these are designed to focus on more fundamental research, the third category of grants would be for multidisciplinary teams working on more applied problems. And the fourth category, research strengthening grants, are designed to help build the research capacity of institutions and of individuals.

One of the significant by-products of all four categories of grants would be a larger pool of resources to attract bright students into graduate study in agricultural, food, and natural disciplines. The job market is very strong for agricultural graduates today, and we do not have enough young Americans pursuing graduate studies in agricultural sciences to replace the people who will retire in the next 5 years.

So, this initiative to expand the Federal investment in agricultural, food, and environmental research is urgently needed to address the problems confronted by this sector. A Federal initiative is needed because the problems are national in scope and the solutions cross State lines.

The President has proposed a significant increase in Federal investment in the Nation's scientific research capacity to ensure the long-term competitiveness of the American economy. It is essential that agricultural, food and associated environmental concerns be an important component of this commitment.

The large Federal outlay of 3 years ago for commodity programs contributed much to short-term sustainability of American agriculture. As a result, the financial health of American agriculture and its associated industries is much stronger today than in the mid-1980's. This increased economic activity has increased the sector's total tax payments. Nevertheless, the sector's long-term sustainability and competitiveness are increasingly being questioned.

While much of the drop in farm program costs and increased tax payments needs to be credited to deficit reduction, a small fraction of those savings and increased tax revenues should be invested in research to solve the important problems that are challenging agriculture's long-term sustainability. This would ensure international competitiveness, while reducing associated environmental problems.

Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Thompson appears at the conclusion of the hearing.]

Mr. BROWN. Thank you very much, Dr. Thompson.

We will hear from Dr. Goodman next, before we question both of you.

STATEMENT OF ROBERT M. GOODMAN, EXECUTIVE VICE PRESIDENT, RESEARCH AND DEVELOPMENT, CALGENE, INC., AND MEMBER, BOARD OF AGRICULTURE, NATIONAL RESEARCH COUNCIL

Mr. GOODMAN. Thank you very much, Mr. Brown.

Members of the committee, Mr. Chairman, I am grateful for the opportunity to be here this afternoon to talk about this very important proposal.

To a degree that your constituencies I think poorly understand, modern agriculture is a highly technologically sophisticated industry. Our agriculture is also a major strategic advantage of the United States in the global economy, as well as in global politics. I believe that our Nation's destiny, as was its past, is inextricably dependent on the health and prosperity and sustainability of our agriculture.

The Board's proposal, "Investing in Research," is a very special and, frankly, rather bold initiative, because it states a new premise about agricultural research in the United States. That premise is that agricultural research should draw on the entire U.S. science and technology research sector. Agricultural research should be conducted and funded in such a way that it will draw on the full breadth of the disciplines and expertise of the U.S. scientific, engineering, and research community.

We have an outstanding agricultural research system, comprised of the Department of Agriculture, State universities, and land grant colleges, and much work also recently in the private sector. The best institutions and units within that system are among the best in the world, but not enough of our agricultural research institutions are in this world class category, and not enough of the world class research capability of the country is devoted to research directed at or in areas relevant to agriculture.

Moreover, the support for some areas of science that we now see to be critical to the future of agriculture is weak, both in relation to the needs of our society and in relation to the opportunities for developing new knowledge from the new technologies from the science base that has recently emerged from past research.

This proposal presents a case for increasing the investment in research and makes, as well, as specific set of recommendations about the breadth of science that should be supported and the mechanism that should be used to allocate that support.

In my written testimony, I have highlighted three aspects of this proposal that are of particular importance to me and I think others of us in agriculture in the private sector, and let me briefly summarize the three points that I have made at greater length in my testimony.

There are many examples of the role that public research has played in advancing agriculture in the past. The list is long and extensive of ways in which our prosperity and the past successes of our agricultural private sector has depended on past achievements of our public sector investment in research, and so it is no wonder that many of us in the private sector have watched with serious misgivings the steady erosion of public support in the U.S. for agricultural research over the past decades.

The situation in the development of biotechnology for agriculture illustrates the truth and the consequences of this erosion quite clearly. Today, without a doubt, the majority of the leading research laboratories in this area are in the private sector. It has been easy to recruit staff away from the public sector, in part, because of the prospects for, and the prospect of, research funding to work in basic science underlying agriculture has been very discouraging in the public sector. Some may say that that is OK. I do not think so.

Because it has not had sufficient support, the public sector is having difficulty keeping up with the need for advanced graduates to work in the private sector, and the high rate of retirements from public sector faculty positions in the next few years will further exacerbate that situation.

Moreover, I think that public concerns over the uses of genetic engineering and other new technologies in agriculture, which are clearly advantageous over some of the existing technologies, is at least in part, directly due to the fact that much of the work has been done in the private sector, rather than in the public sector for which the public intrinsically has a greater degree of confidence.

Public funding of research and the promulgation of knowledge has an important role to play in bringing product development closer to reality, and thereby encouraging institutional and individual investments in the private sector. Again, biotechnology is a good example from recent experience. Large sums of money have been invested in plant biotechnology start-ups. My company alone has raised $113 million over the last 7 years and spent about half of it in R&D. That money would not otherwise have come to agriculture.

While it was not always easy to raise that money, it would have been impossible had the reality of eventual product development from the investment not been believable. It was knowledge from the publicly supported research enterprise, from within and outside the traditional agricultural research system, that made the difference.

The second point, the link between basic science and new prospects and new products for agriculture: Chapter 5 of the proposal makes a very powerful statement, both about the breadth of scientific opportunities and the important applications to which new or advanced knowledge will apply. Particularly, I draw your attention to the tables in chapter 5, 1 through 5 and 5.7, which set forth clearly examples of those areas.

I just thought I would highlight briefly some of the agricultural importance of the work that we are doing in a couple of crops, to illustrate the breadth and the importance, and there are really three key points.

One is canola, providing a new, important domestic crop, probably the most exciting new development in U.S. agriculture in the eighties.

A second area is improving the quality of our food stocks. We and others are working on modifying tomato fruit ripening, with technology that has very broad applicability to address a number of issues in the area of food quality, and making the food supply be-

tween the farm and the supermarket or the processor tighter and less wasteful.

A third area is reducing our dependence on chemical inputs, both from an economic and from an environmental point of view. Our example in this area is in cotton, which is one of the more chemical-intensive U.S. crops. We have seen already a significant reduction in pesticide use through the implementation of pest management techniques. Breeding and other genetic improvements are clearly going to, over the next several years, be proven to further aid in the reduction of those costs for cotton production.

All of our work is based on the past. Supplementing our work on oils is the very important support work the past many years from Dr. Paul Stumpf and many of his associates, Dr. Stumpf here in the room, and now Chief Scientist of the USDA's existing Competitive Research Grants Office.

The key point that Senator Daschle raised in his remarks, I think I would just add to. A very important area of opportunity is the alternative uses of agricultural crops, and that is an area, like many others cited in my written testimony, that needs significant amounts of basic research before we can begin to expect payoffs in product development.

Finally, my third and last point, why competitive grants: The Board has made a very important and a very thoughtful statement about why this proposal is for a competitive grants program. I believe that this program must be via a competitive grant scheme. There is simply no question whatsoever, in my opinion, that the critical objectives of this proposal will best be achieved via a competitive program. It is the only way to open up the agricultural research agenda to the whole of the U.S. science and technology research capacity, it is the proven way of managing the research process, while taking advantage of the fundamental importance of investigator-initiated thinking, creativity and energy in the research process, and it is unambiguously the superior way to maintain both top scientific quality, while making the program responsive to broad objectives set by Government.

I think, as Dr. Thompson has mentioned, the lessons are very clear from the biomedical research in this country since the 1950's, as well as from the very limited program that we have had in competitive grants at the USDA since the late seventies.

I agree that the formula-funded infrastructure of existing agricultural research and delivery system is absolutely critical to the success of our overall national commitment to a prosperous and environmentally responsible agriculture. There are clearly ways in which that infrastructure can and will need to be improved to meet the challenges of the future, but when it comes to research, a major competitive grants program is the missing component of our existing system.

There is a lot of importance in this proposal—the focus on multidisciplinary work, the organizational and institutional recommendations, to which I draw your attention. Let me leave it there and we can go on to questions, if you wish.

Thank you.

[The prepared statement of Mr. Goodman appears at the conclusion of the hearing.]

Mr. BROWN. Thank you very much, Dr. Goodman.

May I just start the questioning by asking you to elaborate briefly on the institutional arrangements contemplated for the administration of this program? We have an existing competitive grants program, as you have indicated, at a relatively low level, $50 million or so. If this new program were enacted, it would be a tenfold expansion. Do you perceive this as creating any difficulties with the existing structure in the Department, in terms of its administration? Do you see a new structure or modifications of the existing structure? Just how do you contemplate handling this?

Mr. THOMPSON. The Board looked at this issue very carefully, Mr. Chairman. After reviewing several options, the Board concluded that the best way to administer such a program would be to remove the CRGO office from the CSRS section of the Science and Education Office and elevate it to the same status as Extension, CSRS, and ARS. We felt that this would give the competitive grants program the prominence it deserved, it would be more consistent with the workload that would be required to administer a program of this size, and it would also remove any potential conflict of interest from among three operating agencies which might themselves be applicants for grants, as well as being involved in the screening of grant proposals.

Mr. GOODMAN. I think it is an important point to reiterate that we see the existing agricultural research system capability, people within that system being competitive applicants for these grants, and that is a key reason for the idea of having a separate new extramural grant funding program within S and E.

Mr. BROWN. You recall that Senator Daschle brought up a point, and this is one that many members have in the back of their mind, that the existing land-grant college research system might fare poorly in the competitive grant program. That is a very real and serious perception, at least, on the part of many Members of Congress, and possibly some in the system itself.

I would like to have you dwell for a moment on how you perceive the land grant system coming out in terms of success in competing with this new grant program. I don't think any of us want to have unrealistic expectations. We know we want to involve people outside the system, but what can we say to reassure those inside the system and those in Congress who are concerned about their health, that they will not be totally dealt out in this new program?

Mr. GOODMAN. The Board's proposal dealt with this issue, again, after much thought and analysis, and coming from the genuine concern that we have and share with Members of the Congress over this issue.

We have clearly identified one of the objectives of this proposal to build both institutions, to strengthen institutions and to strengthen the human resources capacity that we can bring to agricultural research through calling for strengthening grants as being part of the proposal.

I think if you look at the facts, I know that several specific examples where research by members of the USDA and members of university faculties within the system has been supported in a very key way by the existing competitive research program. I know from early service on that and from information from the CRGO

office that there is a large number of grant proposals coming from within the system, they are worthy of the support, that don't get support, and those that do, as we pointed out, get inadequate support.

So, I think the evidence is very clear that the existing agricultural research system has the capacity to and will compete very effectively in this program.

Mr. THOMPSON. Mr. Chairman, I am dean of a school of agriculture in the land-grant system, and I strongly support the use of competitive grants. Almost 45 percent of my research budget is derived from competitive grants and contracts. One of the things that we are finding in many schools of agriculture is that, because the National Institutes of Health and the National Science Foundation programs have so much more money available, that many of our top scientists are getting attracted away from working on food and agricultural problems, to focusing on human medicine problems and other priorities of concern to the NSF or NIH.

For example, I have biochemists in my ag school biochemistry department working on AIDS and cancer research, because it is easier to get money to support research in those areas than it is on diseases of soybeans or pigs. Now, those are important human health problems, but we also have some important problems of plant and animal pathology, that we could just as well have those scientists working on if we had competitive grants programs available in agriculture, instead of just human health.

Mr. BROWN. Thank you.

I will recognize Senator Daschle for any questions he may have.

Senator DASCHLE. Thank you, Mr. Chairman.

Dr. Thompson, you make the analogy or you use as a comparison, I should say, the National Institutes of Health, and indicate that we fall far short of NIH with regard to the resources available. Would you support an effort to bring about the same kind of oversight and scrutiny of the way funding is promulgated in agriculture as they do in NIH?

Mr. THOMPSON. I see no reason why we shouldn't have a comparable oversight system in agriculture.

Senator DASCHLE. You would agree, I guess it is probably universally accepted that there isn't a comparable system today for oversight and general scrutiny of the way money is spent, is that correct?

Mr. THOMPSON. USDA distributes most of its resources through formula funds, as opposed to competitive grants, and they certainly have an oversight system. There is a reporting system required of all faculty members in each of our schools who are supported by Hatch or McIntyre-Stennis money, for example, and certainly there is oversight in the use of those resources.

Similarly, there is oversight in reviewing what we do with money that comes from USDA's competitive grants programs. It is just such an extremely small amount that we don't have the same amount of experience with USDA's program as we do with NIH, for example.

Senator DASCHLE. I really think that is an area that, as we go into this, regardless of how this decision turns relating to money

itself, the scrutiny is going to become an increasingly important factor in all of this.

Talking specifically to the money for a moment, I assume that your support is for anticipated new money. This $500 million is new money, it isn't shifted from formula funding or anything else, is that correct?

Mr. THOMPSON. That is absolutely correct. The genius of our land-grant system has been the yoke responsibility between Federal and State support for the basic infrastructure of laboratories, research farms, and salaries. What has given a lot of our scientists the resources that make them productive and focus their attention on problems of importance to society has been the competitive grants that let them buy the equipment and hire the technicians and graduate students to make their work productive. So, we definitely need new money to make our scientists that we have in place in the basic infrastructure productive on working on these important priorities of today. I would not shift any resources whatsoever. We have down-sized too much already in basic support.

Senator DASCHLE. So, just to clarify with both witnesses, you would not support a proposal that would simply shift funding from some area in agriculture, whether it is research or not, to come up with the $500 million we are talking about in this proposal?

Mr. THOMPSON. The President proposed major new initiatives to support research to make the American economy more competitive. I think food, agriculture, and natural resources is an important area within this overall proposal.

Senator DASCHLE. But it is a little unclear where the money is coming from and that is why I asked the question. I guess everyone can anticipate your enthusiastic endorsement of the proposal. I just want to make sure it is just as enthusiastic for insuring that this be new money and there be enthusiastic opposition, if you will, to any proposal which would shift money in some other element within agriculture to this proposal, and I assume both of you share that view, that it ought not be shifted from some other part of agriculture to this proposal.

Mr. GOODMAN. That is certainly my view and that is the view of the Board and that is very clearly stated in the proposal, Senator. I think if this research initiative is successful, we believe it can be, we believe it will be, we believe the need is absolutely clear, the system that we have today that you are referring to for technology transfer, the infrastructure that Dr. Thompson referred to, will be absolutely critical for technology transfer and the application of this on our farms and in our industries. So, yes, we are making this clear statement of our support for this being new money.

Senator DASCHLE. Throughout the proposal, you emphasized the need for a multidisciplinary team approach. That approach is referenced several times. I would think that we would be using it more right now, that we would have a multidisciplinary team approach in what competitive grant programs there are today, but I don't see any evidence or very little of it. Why don't we have it today?

Mr. GOODMAN. I think the reasons are severalfold, but I probably should begin by responding to your question to say that I think within colleges of agriculture and the land-grant institutions, cer-

tainly within the private sector there is significant multidisciplinary work going on.

Through the competitive grants mechanism, I think you would probably find very little, and I think that relates directly to the size and to the duration of the competitive grants. But having such small short-term grants, with rigorous peer review, you are up against, if you are an investigator, you are up against a real big reality to check over how much work you can do involving how many people; $40,000 a year doesn't go very far.

So, the level of the competitively available support through the existing program selects out any of the creative, broader multidisciplinary kinds of research, for which the demand is clearly there and the talent basis is clearly there to do the work.

Mr. THOMPSON. Certainly, within our basic funding in the schools of agriculture, we are trying to mount multidisciplinary teams. Because today's problems are much too complex for the "Lone Ranger" working alone in one discipline to solve, we are encouraging the creation of multidisciplinary teams. But I agree with Dr. Goodman that the present competitive grants program of USDA puts so little money into each grant, you simply don't have enough to spread around beyond one principal investigator and maybe a grad student or technician working on a very narrow problem.

Senator DASCHLE. My time is up. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Roberts.

Mr. ROBERTS. Well, I don't want to beat a dead horse or a dead pistol horse, but if in face we are the "Lone Ranger," I share the Senator's concern that his trusted steed "Silver" has not been minted in regard to new money, and I am not too sure we can do that.

In my opening statement, I was very supportive and still am very supportive, and I appreciate your time and effort. But Senator Daschle has raised a very good point, and that is we are in the middle of a sequester and if, in fact, the genius of the CSRS lies in some areas, why, the genius of OMB lies in "just saying no," and their concerns are several.

One, where do you get the money; two, if in fact you get the new money, how can you justify each and every old program; three, you are already spending $328 million on earmarking, and then they look rather quizzically at you as to how we are going to justify this, despite all the adjectives and adverbs and good points that are made in behalf of the research initiative.

I guess the question I am going to ask you, you listed six program areas for competitive grants, and say that perhaps, instead of $500 million for competitive research grants, we have something less than that, do you intend to divide them equally in these program areas, or is it on a priority crest of the wave issue that seems to be affecting agriculture? If so, I want to put nutrition and food quality and health at the top, and I am sort of leading you along those lines. Would you care to comment?

Mr. THOMPSON. Well, the Board proposes that each of these areas needs a minimum of $50 million investment. One of the great concerns of the Board is the fact that, in the past, all the competitive grants have been in the plant sciences and the animal sciences,

except for a very brief period when there was a little money put into forestry research.

We recognize that in the list of priority problems—water quality, competitiveness, new product development—we are talking about a broader range of areas of research beyond the plant and animal sciences. We need economics, we need engineering, we need food science, and, therefore, the Board judged that a minimum of a $50 million investment is needed in each of these areas. There is room for negotiation or deliberation on how it ought to be distributed above these levels. I think the Board would feel that we need to get at least $50 million in each of the six areas because there are important problems confronting society that need addressing in each of those areas. If the total were larger than $300 million, then we could talk about how the additional money should be spread among the six areas.

Mr. ROBERTS. So, you are saying your preference is not to pick and choose, but to go across the board with some degree of effort among all six.

Mr. Stenholm has a bill in regards to food quality, food safety, and the natural toxins, et cetera, et cetera, and would you care to amplify just a little bit on what you are talking about when you say nutrition, food quality, and health? We are into a situation now where we have a crisis of confidence, if I can use that term, among some in the American public in our Nation's food supply. I can't think of anything more crucial to the interest of agriculture. I think the question I am looking for is that you're fully supportive of Mr. Stenholm's bill, of which I am a cosponsor, but I will let that go. Would you care to amplify on where you are headed in this regard?

Mr. THOMPSON. In the areas of nutrition, food quality, and health, I agree with you. There has been tremendous damage done to the confidence of the public in the safety of our food supply in the last couple of years. We feel it is very important that all the forces possible be marshaled in the food science and food engineering areas to make sure that we are using all the latest technology, whether it is biotechnology, aseptic processing, or whatever, so that we can assure a doubting public of the safety of its food supply. Then there is a whole range of issues related to the link between diet, nutrition, and health. There are a lot of areas where more research is needed to understand those relationships, and those are two of the areas on which we would certainly put very high priority.

Mr. ROBERTS. Mr. Chairman, I am not sure what we have—oh, we have adjourned. You are safe at this juncture, on a relative basis. I think, at this juncture of time, Mr. Chairman, I will yield back and you can proceed to Mr. Stenholm.

Mr. BROWN. Mr. Stenholm.

Mr. STENHOLM. Thank you, Mr. Chairman.

What role, if any, do matching funds play in the current competitive grants program scheme?

Mr. GOODMAN. Matching funds of what sort?

Mr. STENHOLM. From private industry or universities leveraged with USDA research dollars.

Mr. THOMPSON. As you are well aware, the basic Hatch funding that we enjoy from the Federal Government today requires State match, and the experience is that the States substantially more than match the Federal Hatch appropriations. So, I would say, there is already a good track record of the States more than matching what the Federal Government is already putting into research.

In fact, the very time that Federal support has been eroding over the last 10 to 15 years, the States have been increasing their appropriations, in order to maintain the basic infrastructure and in order to focus more of the researchers' attention on States' specific problems. The universities are already more than matching Federal support, so I suspect there is some potential here.

However, when we are talking about national research priorities, that may cut across State lines or may not be of particular concern to a given State, it may be more difficult in some States, at least, to generate a match for work, on topics that are not viewed as a high-priority State concern. In the same manner, I would hope that the States would appropriate enough funds to support research on high-priority State issues that are not of great concern across the whole country to the Federal Government.

Mr. GOODMAN. As a former recipient of competitive research grants funding for my research program when I was at the University of Illinois, from the USDA, I can say that almost everything that we did with USDA competitive funding had additional sources of support; in my case, from other governmental agencies, largely the Agency for International Development and also from the National Science Foundation, but I don't believe that there is any—well, I am quite certain that there is no requirement for formal matching in the award of CRGO grants then or today, other than the sort that Dr. Thompson has referred to just now.

We did not in our deliberations at the Board seriously weigh the question of whether a Federal initiative of this sort should require matching funds, for example, from industry. I would say that there is a considerable amount of interest, as you know, from industry and work going on in the public research sector, much of it related to agriculture. I myself have been involved in licensing technology from a number of universities here and around the world, about half of them within the traditional agricultural research sector, but fully half of them from outside of it.

Whether it would be good public policy to require matching in this kind of research, which is viewed as being longer-term basic, fundamental, precompetitive or not, I guess personally my view would be guarded on that.

Mr. STENHOLM. Any consideration to the utilization of those, on a matching basis?

Mr. GOODMAN. No, we did not and I personally would not favor it. I think for the broad agenda of publicly funded agriculturally related basic research, Government should really set the agenda, set the areas that are going to be worked in and direct, broadly speaking, the program and rely on individual investigators to respond, as they will, to those broad policies, those broad objectives, and leave it to the private sector to be more involved in the product development and the more applied, specific research that would flow from the basic science.

Mr. THOMPSON. In our experience, the check-off fund generating commodity groups are much more interested in more applied research, rather than the more basic end of the research spectrum. Certainly they would complement more of the multidisciplinary or applied part of what we are proposing in more basic research.

Mr. STENHOLM. Thank you.

Mr. BROWN. Senator Daschle, would you like to take another crack at them?

Senator DASCHLE. Mr. Chairman, just a couple of quick questions, hopefully.

Some concern has been expressed about what effect, if any, this would have on CSRS and the concern that their role will diminish with this proposal. What thoughts do you have on that?

Mr. THOMPSON. I see no reason that CSRS' role should diminish in any way. They do have the administrative responsibility for USDA's very small research grants program, but the net effect on CRGO would not be great if you shifted that small competitive grants program out and elevate it to a full coequal status with CSRS. CSRS will still have significant responsibility in overseeing the basic Hatch and McIntyre-Stennis support to the system.

Senator DASCHLE. The other concern I hear expressed with some frequency is that, clearly, if we are going to get into food safety and the environment, that EPA and FDA ought to be doing that, not agriculture. The first question relating to that concern is: How do we insure we don't duplicate what FDA and EPA may be doing right now? Second, how would you address a concern raised to me some time ago by some nobel laureates who felt very strongly—they were on the health side—and felt very strongly there was absolutely no interface today between agricultural research and nutritional research, that we really needed to focus a lot more on nutrition in NIH, as well as in agriculture, and try to interface those responsibilities a lot more effectively than we have? Do you face that concern and, once again, how do we preclude overlap or duplication?

Mr. GOODMAN. Well, just for my part, I think it would be amusing if it wasn't so serious, the gulf between nutrition, the concerns about nutrition and medical science and agriculture. Agriculture should be taken much more seriously by the medical profession and I think people's health and nutrition should be taken much more seriously by the agricultural sector.

How you do that, in terms of the tools of public policy, I am less clear on, although I do believe that, with sufficient resources to fund agriculturally motivated research of the sort that the Board is proposing, you have a very powerful way of drawing people from the biomedical research community into areas of agricultural importance and begin to forge multidisciplinary links between people with interests in nutrition, livestock nutrition, human nutrition and the properties of plants and the animal foods that they eat.

The other part of your question, with respect to whether that should be an EPA or an FDA, environmental or food and nutrition as opposed to USDA responsibility, I believe very strongly that agricultural research should be the province of agriculture and it is up to agriculture and agricultural research to address itself to the

problems of food safety and nutrition and make the link between those issues and health.

My understanding, just from an institutional point of view, is that the FDA and the EPA's primary role in government are regulatory, rather than knowledge development and technology transfer. That is clearly FDA responsibility as it relates to agriculture, and that to me argues that the USDA is where the research investment should emanate from.

Mr. THOMPSON. The only thing I would add to that is the Board's proposal envisions a priority setting process by which the agency which would administer the competitive grants program would solicit input from many parties in establishing the priority research problems for which they would invite competitive grants proposals in any given year.

Now, the track record is not very good of USDA, EPA, and FDA coordinating on anything, but it would be entirely appropriate for EPA and FDA's interests to be reflected in USDA's priority-setting process.

Senator DASCHLE. By not adding, I assume that you acknowledge the gap that exists between, say, NIH, medicine in general and agriculture on the other side with regard to the lack of interface on nutritional and agricultural research?

Mr. THOMPSON. I have no disagreement and, really, nothing to add to what Dr. Goodman said. I concur that each side needs to take into greater consideration the other's interests and concerns.

Senator DASCHLE. As we go into the farm bill, one area that I would really like to pursue and we would surely like to have your thoughts on is how we might encourage, in law, that that interface begin. I am determined to find a way to do it, and I don't think we can wait much longer. I don't want to mandate anything, for you to do something that isn't practical, but at the same time, I think from a public policy point of view, we just cannot afford to wait any longer and we need your guidance on how we might best do that. This isn't the subject of the hearing today, but certainly as we go down the road in the next couple of months, we will want to return to that issue and discuss it more intelligently.

Mr. GOODMAN. Speaking for my part, I would say we would welcome an opportunity to explore those questions with you, and I am sure Dean Thompson would, too, certainly.

Senator DASCHLE. Thank you.

Mr. BROWN. Let me just address one or two other subjects. First, at the risk of endangering my posture of impartiality, I want to tell you that I am a very strong supporter of this initiative. My concern is whether we will be able to address the reservations that exist within both the Congress and the broader community. From that standpoint, I think your inclusion of a fourth category of research grants is a very wise action on the part of the Board, and I think you probably will need to emphasize and build on that a little bit in terms of what it can do to those land grant institutions that would feel that they were not getting a fair break on competitive grants.

If they can be reassured that they will receive some minimum level of help and upgrading their current capabilities and will continue to receive the formula funds that they are presently getting,

they will see themselves as coming out with a new improvement in their position and may be persuaded to support it, and I am more concerned about the land grant institutions in Mississippi than I am in North Dakota. I hope that you will be able to include that in your strategy.

You had some discussion with Mr. Stenholm about the question of cooperative programs, matching grants, and so forth, and you correctly stated that you want the program to be focused largely on basic research, but you have a number of components here that are not strictly basic research. They are verging on applied research, shall we say, and there is a great deal of interest, particularly in the Senate but also in the House, on how we can expand the market for existing agricultural products, how we can develop new commodities, fill new niches.

In that connection, of course, there is a very substantial private sector interest in the same problem, and I would suggest that this program, while it would be focused mainly on Federal grants for basic research, should not preclude grants which would be shared, they would involve cooperation with the private sector or with other institutions, where those institutions could see some benefit from participating in the research, in other words, if you have a mixed repertoire here that would allow you to capture as many benefits as possible.

What I am particularly interested in is capitalizing on the Senate interest, as evidenced by their passage more than once of research bills directed specifically at the enhancement of market for new uses of agricultural products, that they see a substantial opportunity in this initiative to fulfill the needs that they have expressed.

Is anything that I have said caused consternation in your minds?

Mr. GOODMAN. Not at all. I would just make the further point, which I think reinforced and perhaps extends somewhat your comments, if I understand them correctly, that the needs are very applied in many, many cases. The knowledge base, though, that will be required to do anything about those needs in many cases is very weak and, therefore, you are really starting at what most people would define as basic research, even though you have a very clear applied reason for doing it.

They are also very complex, and to say multidisciplinary research and to apply it to a particular crop plant or to solving disease problems or to understanding the secondary metabolic pathways from which drugs for human medicine can be derived is to call for a significant commitment to what amounts to difficult, expensive basic research. So, I completely agree with you, Mr. Brown.

Mr. BROWN. Well, I have never put much credence in this dichotomy between basic and applied research. We fund what we all claim to be basic research over at NIH and we all know that it is going not produce longer lives for Congressmen in the long run, and we consider that to be a very important practical application of that basic research, and I would like to look at this program somewhat in the same way. [Laughter.]

One last point: The question of where are we going to get the money is going to come up time and time again. You have to get your pitch down right on that. It is not going to come from existing

agricultural programs, I swear to that. Second, it is probably going to come from the same source as the money for the drug initiative, the education initiative, the space initiative, the National Science Foundation initiative, the commuter highways initiative, it is going to come from that same pool of money. We don't know where it is, but that is where it is coming from.

Any other comments from any member of the subcommittees?

Senator DASCHLE. You have said it all, Mr. Chairman.

Mr. BROWN. Thank you very much, gentlemen.

Mr. THOMPSON. Thank you.

Mr. GOODMAN. Thank you, Mr. Chairman.

Mr. BROWN. Our next panel is representatives of the interests of industry: Dr. Richard Stuckey, director of the National Association of Wheat Growers Foundation; Dr. Andrew Jordan, director of technical and research services for the National Cotton Council; and Mr. James Martin, chairman of the research and education committee for the National Cattlemen's Association.

Gentlemen, we are pleased to have you here and to give us a reaction to this initiative from those who are ultimately intended to be benefited, and if you don't feel you are going to be benefited, why, this initiative isn't going to go very far.

Do you want to start out, Mr. Stuckey?

STATEMENT OF RICHARD E. STUCKEY, DIRECTOR, NATIONAL ASSOCIATION OF WHEAT GROWERS FOUNDATION

Mr. STUCKEY. Mr. Chairman and members of the committee, thank you for the opportunity to present the views of the National Association of Wheat Growers Foundation, the education and research arm of the National Association of Wheat Growers on the issue of the agricultural investment report of the National Academy of Sciences.

I am Dick Stuckey, director of the NAWG Foundation. I grew up on a crops and livestock farm in northwest Ohio, where my father and brother continue to be engaged in farming. Three foreign continents have been my home, 2 years in Southeast Asia, 2 years in South America, and just 2 years ago a sabbatical year in Europe. All five of those years were spent working in and observing agriculture. More recently, I have worked for 13½ years as an extension plant pathologist at the University of Kentucky, working in research and education of diseases of small grains, soybeans, and corn. Most recently, I assumed the role as director of the NAWG Foundation, where the major emphasis is research and education projects for the benefit of U.S. wheat producers.

Agriculture and agricultural products are vital to the health of the U.S. economy. The amount of Federal appropriations to agricultural research relative to the national budget, the importance of agriculture to the country, and the excellent return on investment of dollars spent on agricultural research do justify additional investment in agricultural research.

As the demands and the problems facing agriculture have become more and more complex, funding research to solve complex problems has failed to keep pace. The question is: How much longer can we continue to afford our past record of funding and

still remain competitive? Arguably, we have already lost much of our edge against our competition.

I do commend the Senate and House Agriculture Committee members for their interest in agricultural research and the need for additional funding. Your support and efforts on behalf of all of agriculture are appreciated. To cite but one example, Chairman Brown delivered an address entitled "Contemporary Issues: The Critical Issues Facing the Structure and Function of Agricultural Research" to a joint meeting of the Agronomy Society, the Crop Science Society, and the Soil Science Society of America, last November, in Anaheim. I have read this address and concur with his statements regarding the need for rapid adoption of new technology and a systems approach.

The advancements in agricultural science and technology will be made through research. For example, in wheat, the unlocking of the genetic code will permit the development of varieties with drought tolerance, pest resistance and more efficient utilization of needed nutrients. While arguments and disagreements may persist on where and how newly allocated moneys will be spent, of greater importance is the signal that funding such an agricultural initiative will send.

Funding the initiative will issue a statement to young professional scientists that there is interest and support for research activities in agriculture. Our past record has not been encouraging to young scientists when deciding upon whether to enter the agricultural field as a career. The failure to attract and retain our best and brightest minds in the agricultural field has been a travesty.

Support for the national research initiative is highly recommended, provided that funds already appropriated are new moneys, not a reallocation of already committed formula funds, and that as a result the current existing funding appropriations for agricultural research will not be dismantled. Formula funding will need to be continued for projects of regional and State importance, to fill the gaps between high visibility awarded grants, and to maintain equipment and provide incentives for young scientists to do agricultural research. Other State and industry support should assist in funding these projects as well.

The National Academy of Sciences report outlines six program areas. At the onset, it may appear that only one area, that of plant systems, has direct benefit to wheat producers. However, closer scrutiny reveals that all six program areas can and will affect wheat and other major plant commodity crops. The nutrition, food quality and health issues are of increasing importance to the production of U.S. crops and the markets for which crops are designed.

Preservation of our natural resources and the environment are rapidly becoming major issues and concerns facing grain producers. Engineering products and processes will allow traditional crops and their plant parts to have increased uses and influence market expansion, trade, and policy issues. And yes, many of the grain crops are a staple consumption item in animal systems. Thus, the six program areas identified are cleverly interwoven to the point that research in any of these areas has a great potential to affect any given commodity.

Limited research is already being conducted in the six programs areas. However, infusion of additional funds are needed. Agriculture and agricultural research traditionally have been thought of primarily as production research, but this thinking has expanded enormously in recent years to include environmental, new uses, value added products, and many other areas. Research funding has not kept pace with this proliferation, and thus the research dollar has been greatly diluted.

Modified and radical changes in our approach to agricultural production has been suggested and, in fact, demanded by some groups. Before radical methods of agriculture can be supported and dictated, the necessary research must be done. Producers, through many generations and their own experimentation, have already refined their systems, working with the knowledge and base they have to create functional enterprises. Farmers would love to see a plant engineered such that within the capsule—the seed—there would be the ability to resist drought, pests, and provide their own nutritional needs for growth and development. The technology is coming. How fast it arrives and who will get it first depends on our support.

Competitive grants are the mechanism recommended for distribution of funds in the proposal. I believe competitive grants have a successful track record with the National Institutes of Health and the National Science Foundation and those recently instituted with the USDA grants program. Such grants are the most profitable return on investment for discovery of new technology germane to basic science.

The four types of competitive grants recommended constitute a range that will permit individual investigative research to attract talented scientists and students into the area of agricultural research, basic multidisciplinary team grants, mission-linked multidisciplinary team grants and research strengthening grants. These four types of grants would appear to allow specific fundamental, key discovery research to occur and simultaneously permit moneys to assimilate findings into research packages to take to our producers.

In the real world, that of the producers, it is the entire system that must function for success to occur. Like a puzzle, there are specific pieces that are key to its completion. However, the discovery or location of a key piece, namely that done by individual investigator research, does not the puzzle make. All pieces must be assimilated and fitted together, as would be accomplished by the multidisciplinary team and mission-linked team grants. Also, without the frame—the research-strengthening grants—the puzzle soon becomes frayed and unravels. The recommendations made by the panel to increase the size and duration of support has good justification.

In summary, if the United States is to remain the premier agricultural country in the world, increased research funding is a must. Currently, the percent of our national budget committed to agricultural research, compared to many other countries, is embarrassingly low. Our producers are eager and willing to adopt new technologies that are safe, environmentally sound, and profitable. The keys need to be issued to open the locks of information waiting

to be discovered. Getting the best minds into agricultural research will ensure the most effective way to fit the appropriate keys with the locks, and this procedure will be most attractive through increased funding via competitive grants.

Some would say that agricultural research will immediately benefit the producers, which is true. But the major ultimate benefactor will be the consumer. The assurance of an inexpensive, plentiful, safe, and nutritional crop is everyone's goal.

Our farmers are the best they have ever been, they are concerned and doing more than ever before to protect the environment and comply, although at times public perception seems to be to the contrary. Producers are awaiting the tools to do more.

Thank you for this opportunity to testify, and I will be pleased to answer questions at the appropriate time.

[The prepared statement of Mr. Stuckey appears at the conclusion of the hearing.]

Mr. BROWN. Thank you very much, Dr. Stuckey.

Dr. Jordan.

STATEMENT OF ANDREW JORDAN, DIRECTOR, TECHNICAL AND RESEARCH SERVICES, NATIONAL COTTON COUNCIL OF AMERICA

Mr. JORDAN. Good afternoon, Mr. Chairman. My name is Andrew Jordan, and I am staff director, in charge of technical and research services for the National Cotton Council, and I appreciate this opportunity to testify today in support of funding for agricultural research and to provide our views on the national initiative.

The council's full-length testimony has been submitted for the record and, in the interest of time, I will summarize our statement for the hearing this afternoon.

Mr. BROWN. The full text will appear in the record, Dr. Jordan.

Mr. JORDAN. The cotton producers, ginners, cottonseed oil crushers, merchants, warehousemen, cooperatives and textile manufacturers that I represent today understand that a necessary ingredient to build for a healthy future for agriculture depends on investments in research and education today. Therefore, we are pleased with the National Research Council, Board on Agriculture's call for increased Federal investments in research.

In reviewing the proposal, "Investing in Research," we find that the spirit is the same as that proposed for many years by the National Cotton Council, and we commend the Board on Agriculture for their efforts and we support the basic premise that significant new funding for agricultural research is necessary to insure the long-term competitiveness of U.S. agriculture.

While the goals of the initiative are much in keeping with those of the cotton industry, we disagree with the proposed mechanism of funding distribution, that is, solely through competitive grants. The council has long been concerned with the lack of real growth in expenditures for public research and in that regard will welcome any new appropriations for funding increase.

We appreciate the statement that the proposal is against reallocation within the USDA research budget. For too many years, priority research has been funded by shifts in funds, and there are few programs left which can be redirected without adversely affect-

ing other important efforts. The fact is that the core programs of ARS and CSRS are drastically underfunded and are suffering from inadequate support. Pure competitive grants do not address the fundamental problem which limits the effectiveness of the current programs.

While we strongly support new initiatives for agricultural research, the competitive grants approach should not be the sole mechanism for awarding new moneys, nor should it be the major one.

In our assessment, the programs of formula funding to States and appropriations to the ARS historically have proven to be highly efficient. Critics of the current agricultural research system infer that ARS and Hatch funds do not address high-priority national problems. We disagree and argue that they do indeed address critical regional, State, and national needs, and because of their more stable base of funding, the program efforts can be shifted most effectively according to the highest priorities.

The proposal argues for the merits of peer review. However, peer review is not new to the core programs of ARS and CSRS. In fact, for approval of new programs in ARS, peer panels review proposals to assure quality and significance of research. Additionally, periodic peer evaluations of scientists' work are also conducted to assure the highest quality scientific expertise.

The Board's proposal comes at a time in which current ARS programs barely have sufficient funds for salaries, with very little money available to operations. If all new research funds were added to competitive grants, without restoring current efforts to healthier levels, the core programs of ARS and CSRS will continue to shrink. We believe the muscle of these programs has already been cut to the point of rapidly decreasing effectiveness.

The proposal argues that "for a viable competitive grants program, we must maintain a strong core-base program." We agree, but first the base program must be restored to a healthy condition. We share Senator Daschle's concern regarding the administration of the competitive grants, and we would prefer a strong statement calling for allocation of additional new dollars for ARS and CSRS to States, along with increases in competitive grants. We prefer a balanced growth approach, in which new funds are more equitably divided among ARS, Hatch, and competitive grants.

We also feel that congressional participation in setting the agricultural research and extension agenda is appropriate and should actively be sought. Members of Congress, in their linkage to producers and consumers, is a valued resource which should be maximized.

In summary, there is no argument as to whether a major initiative is needed. The only disagreement is on what funding mechanism would be most effective and most efficient. The proposals' failure to explicitly recommend that core programs be strengthened is of serious concern, especially in view of the fact that history has shown that these programs do not receive the highest priority.

Thank you for this opportunity to present our views, and we would be pleased to answer any questions you may have.

[The prepared statement of Mr. Jordan appears at the conclusion of the hearing.]

Mr. BROWN. We thank you, Dr. Jordan. You have given us a very important viewpoint here.

Mr. Martin.

STATEMENT OF JAMES MARTIN, CHAIRMAN, RESEARCH AND EDUCATION COMMITTEE, NATIONAL CATTLEMEN'S ASSOCIATION

Mr. MARTIN. Good afternoon, Mr. Chairman and members of the committee. I am Jim Martin, a cattle producer and farmer from Indiana. I serve as chairman of the research and education committee of the National Cattlemen's Association. I am testifying today on behalf of my colleagues in the cattle business as represented by NCA.

NCA is very pleased that the subject of agricultural research has been elevated to the point that this hearing has been called. We wish to thank both the chairman and the committee for the leadership being shown here today.

Each and every year, we have been called upon by the research community—land grant universities and others—to support increases in agricultural research funding. Without fail, the requests for increases have been across-the-board increases for nearly every line item in the budget. We haven't been enthusiastic in our support, mostly because there was no evidence of a new commitment on the part of the research community. It simply was more of the same.

Production agriculture and the consuming public have benefited greatly from agricultural research, and we want to see funding continue for this effort. However, before we could support any new funding initiative, we want to see a renewed commitment on the part of the research community, some creativity, some new thinking. We believe that such a commitment is embodied in the new $500 million initiative being discussed here, and we are supportive of it. Finally, a bold and ambitious initiative has been launched, and we are pleased to see it and proud to support it.

In our judgment, any new funds for agricultural research should be in the form of competitive grants, a feature of the $500 million initiative. Current formula funding keeps the doors open at our land-grant institutions. Those funds maintain a core group of scientists and educators that are fundamentally important for our future in a high-tech world.

Beyond this, additional funding should be awarded competitively to the very best research efforts.

Yes, this probably means some institutions will probably get a lot more money than others, but that is the way the real world works. We simply can't support this initiative unless it is designed to focus on the highest priority problems and opportunities facing agriculture. We can't support an across-the-board enrichment of every institution now receiving Hatch funds, regardless of the relevance and importance of their research efforts. We believe the same number of dollars will solve a lot more problems and exploit a lot more opportunities, if researchers have to put their best foot for-

ward and compete for funding beyond the base level provided by the formula funds.

In the same sense that American agriculture must compete in the world market on the basis of efficiency and quality, our researchers should actively compete for funds within our own economy on the basis of relevance and ingenuity. Without this structure, our future as a viable competitor in the world market is limited, indeed.

Questions have been raised as to whether the agricultural research community could effectively use $500 million if it suddenly became available. I don't know the answer to that question, but I certainly have doubts that it could. I have no doubt, however, that it could gear up to use $500 million very effectively, but it may take a few years. That is OK. As the old saying goes, the longest journey begins with a single step. We believe it is important to take that first step now and begin breathing new life into our agricultural research system.

Thank you.

[The prepared statement of Mr. Martin appears at the conclusion of the hearing.]

Mr. BROWN. Thank you very much, Mr. Martin.

Senator Daschle.

Senator DASCHLE. Mr. Chairman, I just want to thank our three witnesses for excellent testimony. I think for the most part, although I may have some minor differences with the opinions reflected in the three statements, certainly the general thrust is very similar to the philosophy that I hold with regard to research and all indicate enthusiasm for the proposal, assuming it is new money. I want to thank them for their statements and sharing their thoughts with us this afternoon.

Mr. BROWN. Thank you very much, Senator Daschle.

Let me just make an observation, as a Representative of an urban constituency which used to be agricultural. The common perception amongst a lot of my constituents—I won't say how many, but a lot of them—is that agriculture is in serious trouble, that it despoils the land, despoils the water, contaminates the food, corrupts the environment in general, and costs a hell of a lot of money to the taxpayers.

These are all highly exaggerated opinions, but they are not uncommon. Whatever the factual situation that leads to this may be, agriculture has to go on the offensive and correct it, and in my opinion, it can only do so by a much more aggressive program of research aimed at all of these things, becoming more profitable and reducing the drain on the Treasury, becoming more environmentally benign, being concerned more about the quality of the food, and the various other things that are addressed here by this research initiative.

I don't think most farmers realize yet that they are really being besieged in the present world, and it is not only from the attitude of American consumers and environmentalists, but of course we are being besieged by competition from around the world, and I want to see American agriculture come out of this as world leaders, not as the whipping boy for urban consumers or the defeated rivals of producers in other parts of the world.

I say this just to help explain why I think agriculture has to recognize the need to change in accordance with the very best scientific knowledge we can get in ways that will correct these problems.

I also want to say that I agree, Dr. Jordan, with what you said so eloquently about the core research program. We do need to strengthen that. It is unfortunate that this initiative appears not to be as fully concerned about strengthening the existing system, but you only have to go around to our existing agricultural research facilities to see how much they are in need of additional help, see the loss of some of our best scientific talent and the threat for even more serious losses in the future, to know that we have to revitalize the core program, and it is a good core program.

It may well be that we may need to make some modest changes in this proposal to recognize the importance of strengthening that core program. I don't know at this point what the outcome is going to be, but it is a situation that is going to demand our very best thinking and we want to work very closely with you in the production end of agriculture to make sure that the final outcome provides the benefit to strengthening agriculture that it needs in these times.

Now, that is not really a question, but I wanted to get it off my chest. Do you have any final remarks, any of you, before we complete the hearing?

Mr. STUCKEY. I guess I would see the funding of these competitive grants as enhancing that core that is already there by allowing those researchers at those institutions to do even more, for without it they won't have what they would with it.

Mr. BROWN. I agree with you that the initiative contemplates the ability to do that. It will conceivably, half or more of that money will go to strengthening the existing system, including institutional strengthening grants which can go to the smaller land-grant institutions and can help them to achieve a higher level of quality. I don't think that is sufficiently emphasized in the way the initiative has been presented and we may need to work on that a little bit.

Mr. STUCKEY. You may be aware, just a note that came across the wire today is that the European Community has granted $55 million in European currency units for scientific research to help farmers become more efficient and overcome problems created by overproduction, policies restricting prices and markets, and that was just today, so I think we do have competition from our global neighbors.

Mr. BROWN. Well, that competition is going to get worse. European agriculture is becoming more efficient, not only because of research and development. For example, there has been a major increase in the size of new farm units in the European Community in the last several years. That was one of the things handicapping the efficiency and they knew that and they are making those changes.

Japan will probably begin to do the same thing. They have ridiculously small farms, which handicap their ability to be efficient. The rest of the world is moving ahead very, very quickly. In the United States, the level of funding of agricultural research has been stable or declining in real terms for the last 25 years and that is not good enough.

The testimonial period is over. Thank you very much, gentlemen. We appreciate your being here, and the subcommittees will be adjourned.

[Whereupon, at 4:50 p.m., the subcommittees were adjourned, subject to the call of the Chair.]

[Material submitted for inclusion in the record follows:]

Statement by

Robert L. Thompson
Dean of Agriculture
Purdue University

before the
Department Operations, Research, and
Foreign Agriculture Subcommittee
House Agriculture Committee

and the
Agriculture, Research, and General
Legislation Subcommittee
Senate Agriculture, Nutrition, and
Forestry Committee

October 17, 1989

Mr. Chairmen and Members of the Subcommittees. My name is Robert L. Thompson. I am Dean of Agriculture at Purdue University and serve as a member of the Board on Agriculture of the National Research Council. I am here today to testify in support of the national agricultural, food, and environmental research initiative proposed by the Board on Agriculture.

The Board makes a bold proposal--for the Federal government to increase its annual investment in research on agricultural, food, and environmental problems by $500 million. The decision to recommend an annual investment of this magnitude was not taken lightly. We recognize the urgency of reducing the Federal budget deficit. Nevertheless, the Board concludes that our agricultural, food, and natural resource system is confronting a number of problems of such severity that we cannot afford to wait. The U.S. Government invested tens of billions of dollars in short-term price and income supports to help farmers cope with the financial stress of the mid-1980s. What is proposed here is for the Federal government to invest a much smaller amount in solving problems that will determine the long-run sustainability of American agriculture.

The U.S. agricultural and food system is confronting challenges from many sides. There is great concern about the impact of present production systems on the quality of our water and of the environment more generally. The safety of our food supply and the relationships between diet and health are more frequently being questioned. Both farmers and state governments are concerned about the viability of rural communities and the need to diversify their economic base. Producers of crops in surplus want to see new uses developed for their products. Farmers are concerned that we have lost our cost competitiveness in international markets and wonder why we sell so much less of our agricultural exports in value-added form than many of our competitors.

This list is but a sample of the problems and challenges confronting the U.S. agricultural, food, and natural resource system. Fortunately, breakthroughs in basic research in the biological sciences and engineering over the past two decades provide tremendous opportunities to draw upon science to help solve these problems. Unfortunately, these breakthroughs in basic science and engineering have occurred at a time of stagnating or shrinking Federal investments in agricultural, food, and natural resources research. The capacity of the research system is shrinking at the very time the list of problems and capacity of science to deal with them are growing.

The Federal-state partnership that has invested in agricultural, food, and natural resources research has been one of the great success stories of the past century. The rate of return on those investments has been calculated in the range of 45 to 130 percent. Productivity in U.S. agriculture grew faster than in other American industries and faster than in agriculture in other countries. The U.S. agricultural research success story is envied by other sectors of the U.S. economy and has been emulated by other countries.

Unfortunately, we grew complacent over the past 30 years. Real Federal investment in agricultural, food, and natural resources research has been flat at best. Of greater concern, however, is the fact that we are now being out-invested by other countries. Relative to countries with which we compete in the world market, U.S. investment in the research on which much of our comparative advantage resides is declining. Technological obsolescence can drag down competitiveness in agriculture, just as occurred in other sectors of the American economy.

Federal formula funds and state appropriations jointly provide the basic agricultural, food, and natural resources research infrastructure--including laboratories, research farms, and professors' salaries--at our state universities. As real Federal appropriations have shrunk or failed to keep up with inflation, downsizing has occurred. In order to respond to new priorities, significant amounts of resources have been redeployed among research areas. It is important that the research infrastructure be stabilized at its present size, with no further erosion in capacity.

While the core Federal and state appropriations maintain the basic research infrastructure, it is competitive research grants that make our scientists productive and focus their attention on high priority research issues. Competitive grants attract the best minds in the country to address the priority problems of concern to the granting agency--whether those minds are in land-grant universities, Federal laboratories, private universities, or wherever.

Unfortunately competitive grants for research on agricultural, food, and natural resources problems are inadequate to attract much attention from the nation's best scientists. As a result, we fail to attract talent from outside colleges of agriculture, veterinary medicine, home economics, or forestry to work on solving problems of agriculture, food, and natural resources. Moreover, many of our colleges' top minds are diverted to work

in other areas, e.g. human diseases, for which much greater funding opportunities exist.

In FY 1988 the USDA distributed $40 million in competitive grants while the National Institutes of Health provided grants totaling $6.4 billion. The average USDA grant of $50,000 runs for two years, while NIH grants average $154,900 per year for three to five years. On average the USDA granted less than 11 percent of the requested amount of support to each researcher. Our scientists find that USDA grants are too small to get the job done, involve too much starting and stopping, and rarely last long enough to productively involve graduate students in the research. Moreover, the USDA competitive grants have been available only for plant and animal sciences (and briefly for forestry). There are none available on food safety, engineering, new product development, or rural social sciences--areas of science critical in addressing many of the problems described above.

The objective of this initiative is to fix the problems with USDA's competitive grants program in order to attract some of the best minds in the country to help solve the pressing problems of the agricultural, food, and natural resources system. The initiative proposes to do this by increasing the number of grants, their average size, and their duration. It would broaden the coverage to include:

- Plant systems
- Animal systems
- Nutrition, food quality, and health
- Natural resources and the environment
- Engineering, products, and processes
- Markets, trade, and policy

Four different types of grants are envisioned: the first, principal investigator grants, have a proven track record in the highly successful competitive grants programs of NSF and NIH. However, recognizing that many of today's problems in the agricultural, food, and natural resources system are too complex for a lone scientist working in a single discipline to solve, the second category proposed are for multidisciplinary research team grants. While these are designed to focus on more fundamental research, the third category of grants would be for multidisciplinary teams working on more applied problems. The fourth category, research strengthening grants, are designed to help build the research capacity of institutions and of individuals.

One of the significant byproducts of all four categories of grants would be a larger pool of resources to attract bright students into graduate study in agricultural, food, and natural resources disciplines. The job market is very strong for agricultural graduates with a B.S. degree. We do not have enough Americans pursuing graduate studies in agricultural sciences today to replace the people who will retire over the next five years.

This initiative to expand the Federal investment in agricultural,

food, and environmental research is urgently needed to address the problems confronted by this sector. A Federal initiative is needed because the problems are national in scope and the solutions cross state lines. As Federal appropriations have shrunk, many states have increased their appropriations for salaries and to invest in research on important state problems . The states cannot be expected to individually bear the cost of research to solve national problems such as discussed above.

The President has proposed a significant increase in Federal investment in the nation's scientific research capacity to ensure the long-term competitiveness of the American economy. It is essential that agricultural, food, and associated environmental concerns be an important component of this commitment. The cost of the agricultural commodity programs has fallen from $26 billion to $11 billion since FY 1986. The large outlays of three years ago contributed much to the short-term sustainability of American agriculture. The financial health of American agriculture and of associated industries is much stronger today than in the mid-1980s. This increased economic activity has increased the sector's total tax payments. Nevertheless, the sector's long-term sustainability and competitiveness are increasingly being questioned. While much of the drop in farm program costs and increased tax payments need to be credited to deficit reduction, a small fraction of those savings and increased tax revenues should be invested in research to solve the important problems that are challenging agriculture's long-term sustainability. This would ensure international competitiveness while reducing associated environmental problems.

Investing in Research:
Why the NRC Board on Agriculture Proposal for a Major Increase in Competitive Grants for Agriculture Should be a National Priority

Invited Testimony
by
Dr. Robert M. Goodman *

Mr. Chairmen, I am grateful for this opportunity to testify before your joint hearing on this very important Proposal issued by the National Research Council's Board on Agriculture. There is little that is closer to my heart, both professionally and personally, than the health of the future of agriculture of this country. I believe that our nation's destiny, as was its past, is inextricably dependent on the health and prosperity of our agriculture.

To a degree that your constituencies very poorly understand, modern agriculture is a highly technologically sophisticated industry. Our agriculture is also a major strategic advantage of the US in the global economy as well as in global politics. The question we are here today to discuss is the Board on Agriculture's carefully considered and strongly held view that the nation now needs to recommit itself to the future of this strategic and complex sector of the nation's economy. The Board has over the past several years identified in its reports many opportunities to strengthen the position of our agriculture. We have addressed new technologies, human resource needs, national regulatory policy, and the research agenda.

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The Board's latest proposal, Investing in Research, is a very special and frankly rather bold initiative because it states a new premise about agricultural research in the United States. That premise is that agricultural research should draw on "the entire US science and technology research sector." Agricultural research should be conducted and funded in such a way that will draw on the full breadth of the disciplines and expertise of the US scientific and engineering research community.

The US has an outstanding agricultural research system comprised of the US Department of Agriculture, the state universities and Land-Grant colleges and the private sector. The best institutions and units within that system are among the best in the world. But not enough of our agricultural research institutions are in this world-class category and not enough of the world-class research capability of the US is devoted to research directed at or in areas relevant to agriculture. Moreover, the support for some areas of science that we now see as critical to the future of agriculture is weak, both in relation to the needs of society and in relation to the opportunities for developing new knowledge. This is the true of areas such as ecosystem studies, hydrology, regulation of the global climate, biological diversity, population ecology, disease resistance, post-harvest physiology, stress tolerance, new uses and value-added traits for crop plants, resource conservation, risk assessment, and many others identified in the Proposal.

This Proposal presents a case for increasing the investment in research and makes as well a specific set of recommendations about the breadth of science that should be supported and the mechanism that should be used to allocate that support. I wish to highlight three aspects of this Proposal that are of particular importance to me and others in agriculture in the private sector.

The Importance of Publicly Funded Research to the Private Sector

The private sector in American agriculture is a very complex mixture of farms and ranches, heavy manufacturing, chemical industries, transportation, services, finance, seeds, veterinary and other input suppliers, and the food and fiber processing industries. But all of these businesses have some interests in common. Primary among their common interests is a healthy, productive and successful research infrastructure that will develop the knowledge upon which new products and new tools for decision-making, distribution and successful competition in the market place will make possible. Even in agribusiness subsectors that can afford to invest heavily in R&D themselves, there is a fundamental reliance on basic research in the public sector, both for the new knowledge it produces and also for the advanced education of its own R&D employees.

Examples abound of the role of public research in advancing agriculture in the past. It was publicly funded research that led to the revolution of hybrid seed corn. Basic synthetic organic chemistry made the agrichemical industry

possible. Publicly funded research (from the NSF, NIH, the American Cancer Society, and the West German and Belgian governments) made available the knowledge from which the primary genetic engineering vector for plants was developed. Disease control in livestock, milk fortification, preservation and food processing methods, economic theories ..... the list goes on and on of ways in which our prosperity and the past successes of our agricultural private sector has depended on the past achievements of our public sector investment in research.

It is no wonder then that many of us in the private sector have watched with serious misgivings the steady erosion of public support in the US for agricultural research over the past 10-15 years. The situation in the development of biotechnology for agricultural uses illustrates the truth and the consequences of this erosion very clearly. Today without a doubt the majority of the leading research laboratories on the forefront of plant biotechnology are in the private sector. It has not been difficult to recruit staff away from the public sector in part because the prospects for, and the prospect of, research funding to work in basic plant science has been very discouraging in the public sector. You may say, well that's OK. But is it really? I don't think so. Because it has not had sufficient support, the public sector is having difficulty keeping up with the need for advanced graduates to work in the private sector, and a high rate of retirements from public sector faculty positions in the next few years will further exacerbate this problem. Moreover, the public concerns over the uses of genetic engineering in agriculture are at least in part directly due to the fact that much of the work in this area is done by big (or small) private companies rather than in the public sector for which the public intrinsically has a greater degree of trust.

Moreover, the public funding of research and the promulgation of knowledge I think has an important role to play in bringing product development closer to reality and thereby encouraging institutional and individual investments in the agricultural sector. Again, biotechnology is perhaps an example from recent experience. Large sums of money have been invested in the plant biotechnology start-ups (Calgene alone has raised $113 million over the past 7 years and spent nearly half of that amount on R&D) that would otherwise not have come to agriculture. While it was not always easy to raise this money, it would have been impossible had the reality of eventual product development from the investment not been believable. It was knowledge from publicly-supported research, from within and outside the traditional agricultural research system, that made the difference.

How Basic Science is Linked to New Prospects and New Products for Agriculture

The documented erosion of publicly supported agricultural research in the United States has placed the country in a weak position to take advantage of or to contribute to the major developments in the knowledge base that new research methods, arising largely from publicly funded biomedical research,

make possible. Chapter 5 of the Proposal makes a powerful statement, both about the breadth of scientific opportunities and the important applications to which new or advanced knowledge will apply. I particularly draw your attention to the tables (5.1-5, 5.7) which set forth examples of the areas of science and examples of the practical applications to which they apply.

Let me now turn to some specific examples that illustrate the importance of public research findings to advances in agricultural technologies. Because I know them best, and because I think you will be rather interested in some of the details, I will reflect on this topic using examples from our work at Calgene. I have included with my testimony a full description of Calgene's research and product development programs.

Calgene is one example of what's new, and what's news, in American agriculture. When the implications for genetic manipulation, using recombinant DNA technology began to occur to scientists and businessmen, one of the areas in which applications and opportunities were sought was plant agriculture. Calgene was one of those companies, started in the biotech start-up era of the early 1980s. The promise was faster, more precise and more commercially powerful modifications of plant genetic traits to make new or better products from plants. Founded in late 1980, Calgene's commercial strategy began to take shape in 1984, after the technical ability to engineer plants was proven and an early prototype was produced. Substantial fund raising occurred in 1984 (venture capital), 1986 (initial public offering) and 1989 (convertible preferred stock offering). Starting in 1982, the company has had an increasing portfolio of funded research agreements with other larger companies, both in the US (e.g. Campbell Soup, Procter and Gamble) and abroad (Rhone Poulenc Agrochimie, Ciba-Geigy, Roussel-Uclaf, Nippon Steel).

Calgene is a genetic engineering-based seed, food and specialty chemical company. Our work is focused on industrial and edible plant oils and carbohydrates, superior agronomic traits in certain seed markets, and improved harvest characteristics in fruits such as tomato. Our core crops are rapeseed (canola), alfalfa, tomato, cotton and potato. Among recent advances in our research program are these:

- Development and testing of DNA sequences that specifically control gene expression in developing fruits and seeds of tomato and rapeseed, respectively. These sequences will be used to improve qualities in tomato both for the fresh market and processing, and modify oil composition in rapeseed.

- Successful development of antisense technology to dramatically reduce the level of a tomato fruit enzyme that is responsible for softening. Field trials to evaluate the processing characteristics and fresh fruit quality of engineered plants were conducted in 1989.

- Field testing of genetically engineered tomatoes demonstrated commercially useful levels of tolerance to the herbicide bromoxynil. The successful field

performance of an herbicide tolerance gene completes the recombinant DNA groundwork required for the commercial launch of Calgene's first genetically engineered product, bromoxynil tolerant cotton, which received its first field trial in 1989.

- Development of gene transfer systems for cotton and alfalfa.
- Development of genes for insect tolerance.
- Identification and isolation of the genes that will be used to engineer the composition of new high-value industrial and edible oils.

The point of this list of recent achievements is that to accomplish our business objectives we have had to invest considerable time and resources in basic research. And Calgene is only one of numerous companies working in this area.

Let me now briefly summarize the agricultural importance of the work we are doing in four crops - canola (rapeseed), tomato, cotton and alfalfa.

Canola is probably the most exciting new development in US agriculture in the 80s. Canadian plant breeders have developed varieties of rapeseed with a very desirable oil composition for many food uses. Their success is now being exploited by Calgene and several other companies working to introduce canola production to US farmers. The crop will be planted in the spring and harvested in the fall in the upper Midwest; in other more moderate climates it will be planted in the fall and harvested in early summer ("winter" rapeseed).

Unlike other oilseed crops, rapeseed can be routinely engineered using recombinant DNA technology. Therefore, several groups have targeted rapeseed as the crop plant of choice to attempt to engineer other compositions of the fatty acids in the oil. If successful, their work will lead to domestic sources of vegetable oils that will be useful in a variety of industries. Some of these uses may bring much higher prices to the producer than the commodity vegetable oils we now produce. Such uses include surfactants, detergents, lubricants, and chemical feedstocks for other products.

Tomato improvement for processing uses is another example of a remarkable success in plant breeding. Modern processing tomato production now has highly productive varieties with high sugar to water ratios that produce a high proportion of ripe fruit more or less all at the same time. These varieties can be further improved, however, and that improvement is the goal of several public and private sector research programs. My colleagues have shown by genetic engineering that they can reduce the incidence of rot in ripe tomato fruits as well as increase the solids and improve other processing qualities. Others have used advanced genetic tools based on recombinant DNA to make more rapid and more certain progress in conventional plant breeding for tomato improvement. There is a possibility that these developments will even result in

time in a more tasty fresh market tomato that can be harvested ripe, shipped safely and sold in supermarkets.

Cotton is one of the more chemical-intensive of US crops. The partial adoption of integrated pest management techniques has resulted in significant reductions in insecticide use over the past ten years, but the costs of insect and weed control chemicals in cotton production are typically ten times greater than the cost of seed on a per acre basis. There is a great opportunity, therefore, to reduce production costs for the grower, reduce pesticide impacts on the environment and increase the profitability of seed suppliers by providing genetically improved cotton with insect, disease and selected herbicide tolerances. In 1989, field trials were conducted in Mississippi of engineered cotton for insect resistance and for compatibility with a highly effective, environmentally safe weed control chemical that kills nonengineered cotton. Advances in plant breeding are also contributing to this agenda, with improved insect and disease resistant materials.

Alfalfa is the nation's leading forage crop. Because it is usually grown as a perennial, with typical stands being harvested 3-6 times per year for 3-5 years before replanting, alfalfa is particularly sensitive to diseases and pests. Because it is fed to our livestock the use of chemicals on the crop is undesirable.

Therefore, genetic improvement is the superior way to provide enhanced yields. There is also great interest in and promise for improving the nutritional quality of the crop by increasing the protein content of the leaves and stems. Some of the most advanced work on nutritional quality factors is being done at a USDA facility at the University of Wisconsin and in a government laboratory in Australia.

As this review of our business and product development program indicates, Calgene and its investors have a lot at stake when it comes to agricultural research advances. Our work on rapeseed oils is possible because of the pioneering biochemistry studies of Dr. Paul Stumpf, formerly a professor at UC Davis and now Chief Scientist of the USDA's Competitive Research Grants Office, and his students. Our work in tomato is the outgrowth of years of study on tomato genetics and physiology, including that of Dr. Charles Rick, also at UC Davis.

On the other hand, our work in agronomic improvements, such as insect tolerance, disease resistance, forage quality, etc., lag behind in their potential to yield useful products because the investment in basic research has not been as sustained as in other areas. Another very important area of opportunity is alternative uses of agricultural crops. But again, as the Board's Proposal points out, more research is needed to make these opportunities real. Do not underestimate either the difficulty or the potential payoff of this research. We know very little about the biochemistry of the synthesis in plants of secondary metabolites (which include the therapeutic drugs derived from plants for human medicine and are an important part of the arsenal for plants defense against

insects and pathogens). We know very little about growth and development in plants (which is fundamental to the architecture of plants and therefore to yields). We have very little engineering knowledge that will be required if we are to develop the technology to use plants as sources of feedstocks to replace petrochemicals (e.g. for plastics, fuels, etc). Advances in these areas will make a mighty contribution to the prosperity of agriculture and of the nation in the future. We must start now by laying the research base.

Why Competitive Grants?

I call your attention to the treatment of this important question in the Proposal itself, on pages 34-39. The Board has made a very important, and very thoughtful, statement about why this Proposal is for a competitive grants program. Let me just reiterate my conviction that this program must be via a competitive grants scheme. There is simply no question whatsoever in my opinion that the critical objectives of this Proposal will be best achieved via a competitive program. That is the only way to open up the agricultural research agenda to the whole of the US science and technology research capacity. It is the proven way of managing the research process while taking advantage of the fundamental importance of investigator-initiated thinking, creativity and energy in the research process. And it is unambiguously the superior way to maintain both top scientific quality while making the program responsive to broad objectives set by government. The lessons are very clear from the experience we have had with biomedical research in this country since the 1950s. The successes of the very limited program for competitive grants at the USDA since the late 1970s support this conclusion.

Let me hasten to add that the formula-funded infrastructure of the existing agricultural research and delivery system is likewise absolutely critical to the successes of our overall national commitment to a prosperous and environmentally responsible agriculture. There are clearly ways in which that infrastructure can and will need to be improved to meet the challenges of the future. But, when it comes to **investing in research a major competitive grants program is the missing component of our existing system.**

Again, a lot of thought, discussion, and documentation has gone into the Board's recommendation on this critical point. Competitive grants are the way to achieve the objectives of this Proposal.

There is much else of importance in this Proposal, such as the focus on multidisciplinary work and the organizational and institutional recommendations, to which I draw your attention. I will be pleased to respond to your questions about these or other aspects of this Proposal.

Thank you.

(Attachment follows:)

A Summary of Calgene Research and Product Development

Calgene's primary product development efforts and business operations are focused on five core crops: rapeseed, tomato, cotton, alfalfa and potato.

Product Development - The Rapeseed/Canola Story

Rapeseed oil is the leading vegetable oil crop in Canada, Asia and Western Europe. It was introduced into commercial production in the United States in 1986.

Calgene has a three-pronged rapeseed strategy:

- To develop high-yielding rapeseed varieties that produce canola (edible rapeseed) oil and to market the seeds to farmers in the United States through Calgene's Ameri-Can subsidiary.
- To develop high-yielding rapeseed varieties that produce HEAR (industrial rapeseed) oil, to have this crop grown and processed under contract to Calgene and to sell the oil through its Calgene Chemical subsidiary.
- To genetically engineer rapeseed varieties that will produce high-value, speciality edible and industrial oils and very low cost commodity industrial oils; to have these crops grown and processed under contract to Calgene; to sell the oils to Calgene's oil corporate partners, including the Procter & Gamble Company and Nippon Steel Company; and to market the oils directly to other customers in selected market segments.

Rapeseed - Canola

Since canola has the lowest level of saturated fat of any edible oil, Calgene believes that canola may become a new "healthful" oil product for the U.S. food industry and a major new crop for U.S. agriculture. Following the Food and Drug Administration award of Generally Regarded As Safe ("GRAS") status to canola oil in 1985, several major U.S. food companies have introduced canola-based products into the domestic market. The U.S. Department of Agriculture ("USDA") estimates that 440 million pounds of canola oil will be imported into the U.S. in 1989. Calgene estimates that the 1989 U.S. canola crop currently exceed 15 billion pounds annually. Ameri-Can, Calgene's canola planting seed subsidiary, is the first U.S.-based canola seed company with breeding and production capabilities. Ameri-Can has obtained from the University of Idaho exclusive marketing rights to Cascade, the first winter canola variety bred in and for the U.S. Initial sales of Cascade to U.S. farmers began in the summer of 1988. Ameri-Can plans to introduce in 1989 additional varieties developed by Calgene from licensed breeding material.

The objective of Calgene's canola breeding program, initiated in 1985, is to develop superior performing varieties of canola for cultivation in major U.S. agricultural regions, particularly the midwest, midsouth, south and southeast, the principal growing regions for winter varieties of canola. The variety development staff now includes eight professionals overseeing trials at forty-four locations in twenty states. Breeding material has been obtained under license from Daehnfeldt S.A. and Norddeutsche Pflanzensucht Hans-Georg Lembke KG, two leading European seed companies, and the People's Republic of China, which operates one of the world's largest rapeseed breeding programs. Calgene is also funding a series of agronomic studies at the University of Tennessee, the University of Missouri and the University of Kentucky to develop cultivation practices best suited for U.S. growing conditions.

In June 1989, Calgene and Central Soya, one of the world's leading oilseed processors, formed an equally owned joint venture called U.S. Canola Processors, Inc. to crush, refine and market canola oil and meal. Calgene believes that this joint venture will be an important factor in accelerating U.S. canola production by providing U.S. winter canola growers with the first readily accessible facility to crush and refine canola. Central Soya's existing soybean processing facilities located in Chattanooga, Tennessee, has been modified to enable it to crush and refine canola while retaining its soybean processing capability. The joint venture also intends to process HEAR currently being produced by growers in the midsouth under contract to Calgene. The plant will begin canola processing operations on the 1989 rapeseed crop in August. Central Soya will continue to own the soybean processing facility, except for the joint venture's equipment related to crushing and refining canola. The joint venture has entered into an agreement with Central Soya providing for the joint venture's utilization of the processing facilities on a time-allocated basis and the payment of usage fees by the joint venture based on Central Soya's costs allocated to the period during which the facilities are used by the joint venture.

Rapeseed - HEAR Oil

HEAR (High Erucic Acid Rapeseed) oil is an industrial rapeseed oil used as a feedstock by oleochemical processors to produce amides, erucic acid and a number of different amines, alcohols and other chemical intermediates which are used in the production of plastics, water repellants, wax-coated paper and corrosion preventatives. HEAR oil is also used in the manufacture of specialty lubricants, vulcanizers, ribbon inks and soaps. Beginning in 1986, Calgene established the only U.S. production source of HEAR oil by contracting with U.S. growers to produce 2,400 acres of industrial rapeseed varieties in the midsouth. In 1987 this acreage had increased to 3,400 and by 1988 to 4,500 with an estimated yield of over four million pounds of HEAR oil. In the 1989-90 season the acreage will rise to more than 15,000. Calgene's rapeseed breeding and agronomic research program is also developing superior performing varieties of HEAR rapeseed which provide higher yield, disease resistance and enhanced standability.

Calgene Chemical, Calgene's specialty oils subsidiary, is a leading marketer of HEAR oil to U.S. industry. Acquired in May 1986 as "Agro Ingredients", Calgene Chemical sold 1.4 million pounds of HEAR oil in fiscal 1987 and 2.5 million pounds in fiscal 1988.

Rapeseed - Genetically Engineered Oils

Calgene is developing five specialty oils products using recombinant DNA technology. The target genes have been cloned or are in various stages of protein purification. Two genes have been introduced to plant tissues and are undergoing greenhouse testing. Calgene scientists have also developed promoters which permit gene expression to occur specifically in the seed, where oil synthesis takes place, and have established a routine, highly efficient rapeseed transformation system. Partial funding of the genetically engineered oils research and development is provided by the Procter & Gamble Company and Nippon Steel Company.

Cotton - Decreasing the Economic and Environmental Costs of Weed and Pest Control

Calgene's cotton product development objectives are to genetically engineer cotton for improved field performance by lowering cost of cultivation and increasing yields, and for improved fiber quality. Calgene is developing cotton plants tolerant to selected herbicides which are effective in controlling weeds, and resistant to specific insect pests such as the bowl weevil and the budworm. In 1987, according to USDA data, Mississippi Delta farmers spent approximately $100 per acre on weed and insect control. The Company's

strategy is to develop cotton plants whose seed can be sold at a premium because of the farmer's reduced expenditures for weed and insect control. Field trials with plants containing herbicide tolerance genes began in June 1989. Insect resistant plants are currently in greenhouse evaluation and field trials are scheduled for 1989.

Calgene acquired Stoneville Pedigreed Seed Company, a leading producer of proprietary cotton seed, in December 1986. Stoneville has marketed cotton varieties for over 65 years and currently holds the second largest market share in an area comprising approximately three million acres in the states of Alabama, Arkansas, Louisiana, Mississippi, Missouri and Tennessee. Stoneville's breeding program, based in Mississippi and Arizona, has developed several new varieties which are being evaluated in comparative government field trials. In 1988, Stoneville introduced its newest variety of cotton, Stoneville 453™, which has demonstrated improved yields.

Stoneville cotton seed is grown under contract by farmers and processed at Stoneville's facilities in Mississippi and Arizona. In 1989, Stoneville completed construction and began processing through its new cotton seed delinting facility in Mississippi. Designed to maximize seed quality and production efficiency, this facility increased Stoneville's total bulk seed processing capacity from 8,000 tones to 20,000 tons. Stoneville's sales force markets its varieties through seed distributors and dealers.

Tomato - Improved Food Quality

Calgene's tomato program efforts are directed toward genetically engineering increased fruit solid content and extended shelf life. Calgene scientists have cloned two genes to enhance tomato solids and viscosity, which are important properties to tomato processors. Calgene scientists have also succeeded in substantially reducing the presence of a key enzyme involved in the softening of tomatoes, resulting in the development of tomatoes with delayed degradation properties. Calgene believes that this advance will result in a significant reduction in spoilage and improvement in taste. The Company began field trials with tomatoes engineered for extended shelf life in December 1988 in Mexico and recently began harvesting. The additional field trials were planted in May 1989 in California.

Plant Genetics, a new Calgene subsidiary, is currently selling five varieties of processing tomato seed conventionally bred for high solids content, which reduces tomato processors' energy costs associated with removing water from the tomato. These tomato varieties were developed for Plant Genetics by a third party and are owned by Plant Genetics. A percentage royalty is payable to the developer based on net sales of each variety for a period of five years following the first commercial sale of the variety. Hybrid processing tomato seed is grown for Plant Genetics under contract by companies in Taiwan, India and China. Plant Genetics currently contracts for its tomato seed processing and sells its hybrid processing tomato seed through seed dealers.

Other Crops - Alfalfa and Potato

In the near term, Calgene's alfalfa product development focuses on improving yields and increasing the spectrum and level of disease and insect resistance. The Company's longer term product development efforts are focused on developing more readily digestible high protein varieties, varieties tolerant to aluminum toxicity which is a major deterrent to expanding alfalfa acreage, and varieties with high regeneration capacity in tissue and cell culture.

The Company currently markets 16 proprietary varieties of alfalfa seed domestically and internationally, including ten varieties developed by the Company and six varieties purchased in 1987. The Company also distributes certain public (non-proprietary) varieties

of alfalfa seed. The Company subcontracts the growing, harvesting and processing of its entire alfalfa product line, a common practice within the industry. The Company markets its alfalfa seed through a network of seed distributors and dealers in the midwestern, northwestern and southwestern United States, which are the primary alfalfa markets. The Company is also negotiating with large distributors to market several alfalfa varieties under long-term private label marketing arrangements. The Company currently has marketing and sales agents in Argentina, Lebanon, Japan, Taiwan and Hong Kong and intends to establish additional agents to market and distribute alfalfa seed in other countries.

The Company's potato program objectives are to develop improved potato varieties attractive to both processors and growers. Potato processors desire varieties with high solids, low reducing sugars and bruise tolerance. In addition to these characteristics, growers seek varieties with improved disease resistance and high yields. Through its research and development agreement with ML Technology Ventures, L.P., the Company is developing potato varieties with these qualities. The Company's first proprietary potato variety, PGI™ Shasta, has exhibited attractive agronomic and processing performance in tests carried out in major potato growing areas. Initial field trials are being conducted in 1989 to evaluate virus resistance and are planned for high solids and low sugar varieties in 1990. One or more years of preliminary field trials will be required to identify candidate varieties. Superior candidate varieties will then be advanced through one or more years of additional agronomic field trials prior to commercialization.

Plant Genetics is a leading developer and marketer of tubers, which it sells under the NU-SPUD™ trademark. Plant Genetics sells NU-SPUD™ products directly to potato growers and processors in the United States, Canada, Argentina, Mexico and Thailand. In November 1986, Plant Genetics formed a joint venture company named Twygen Ltd. ("Twygen") with Twyford Seed Limited, a major seed company in the United Kingdom. Twygen produces, markets and sells NU-SPUD™ potato products in the European Economic Community. Plant Genetics has also licensed its NU-SPUD™ production technology to Calbee potato company for use in Japan. Calbee is a major producer of potato chips in Japan.

Plant Genetics' U.S. potato business strategy is to build a vertically integrated seed potato business that supplies planting stock directly to growers who produce potatoes for commercial sale as opposed to supplying other seed potato growers. Plant Genetics currently contracts for field production using NU-SPUD™ tubers as the initial planting stock. The Company believes that its potato strategy will allow it to protect the gross margins on its proprietary potato varieties, significantly reduce the production scale -up cycle and expand its market opportunities.

Statement of Dr. Richard E. Stuckey
Director
National Association of Wheat Growers Foundation
Before the
Department Operations, Research, and Foreign Agriculture Subcommittee
of the House Agriculture Committee
Agricultural Research and General Legislative Subcommittee
of the Senate Agricultural Committee
On Agricultural Investment
October 17, 1989

Mr. Chairman and Members of the Committee:
Thank you for this opportunity to present the views of the National Association of Wheat Growers Foundation, the education and research arm of the National Association of Wheat Growers, on the issue of the Agricultural Investment Report by the National Academy of Sciences.

I am Dick Stuckey, Director of the NAWG Foundation. I grew up on a crops and livestock farm in Northwest Ohio, where my father and brother continue to be engaged in farming. Three foreign continents have been my home: two years in Southeast Asia, two years in South America, and just two years ago, a sabbatical year in Europe, all five of those years were spent working and observing agriculture. More recently, I have worked for thirteen and a half years as an extension plant pathologist at the University of Kentucky, working in research and education of diseases of small grains, soybeans, and corn. Most recently, I assumed the role of Director of the NAWG Foundation, where the major emphasis is research and education projects for the benefit of US wheat producers.

Agriculture and agricultural products are vital to the health of the US economy. The amount of federal appropriations to agricultural research relative to the national budget, the importance of agriculture to the country, and the excellent return on investment of dollars spent on agricultural research justify additional investment in agricultural research.

As the demands and the problems facing agriculture have become more and more complex, funding research to solve complex problems has failed to keep pace. The question is how much longer can we continue to afford our past record of funding and still remain competitive? Arguably we have already lost much of our edge against our competition.

I commend the Senate and House Agricultural Committee Members for their interest in agricultural research and the need for additional funding. Your support and efforts on behalf of agriculture are appreciated. To cite one example, Chairman Brown delivered an address entitled, "Contemporary Issues: The Critical Issues Facing the Structure and Function of Agricultural Research" to a joint meeting of the Agronomy Society of America, the Crop Science Society of America, and the Soil Science Society of America joint meetings last November in Anaheim. I have read this address and concur with his statements, regarding the need for rapid adoption of new technology and a systems approach.

The advancements in agricultural science and technology will be made through research. For example, in wheat, the unlocking of the genetic code will permit the development of varieties with drought tolerance, pest resistance and more efficient utilization of needed nutrients. While arguments and disagreements may persist on where and how newly allocated

monies will be spent, of greater importance is the signal that funding such an agricultural initiative will send. Funding the initiative will issue a statement to young professional scientists that there is interest and support for research activities in agriculture. Our past record has not been encouraging to young scientists when deciding upon whether to enter the agricultural field as a career. The failure to attract and retain our best and brightest minds in the agricultural field has been a travesty.

Support for the national research initiative is highly recommended provided that funds appropriated are new monies, not a reallocation of already committed formula funds, and that as a result the current existing funding appropriations for agricultural research will not be dismantled. Formula funding will need to be continued for projects of regional and state importance, to fill the gaps between high visibility awarded grants, and to maintain equipment and provide incentives for young scientists to do agricultural research. Other state and industry support should assist in funding these projects as well.

The National Academy of Sciences Report outlines six proposed program areas. At the onset, it may appear that only one area, that of plant systems, has direct benefit to wheat producers. However, closer scrutiny reveals that all six program areas can and will affect wheat and other major plant commodity crops. The nutrition, food quality and health issues are of increasing importance to the production of U.S. crops and the markets for which crops are designed. Preservation of our natural resources and the environment are rapidly becoming major issues and concerns facing grain producers. Engineering, products, and processes will allow traditional crops and their plant parts to have increased uses and influence market expansion, trade and policy issues. And, of course, many grain crops are a staple consumption item in animal systems. Thus, the six program areas identified are cleverly interwoven to the point that research in any of these areas has a great potential to affect any given commodity.

Limited research is already being conducted in the six program areas. However infusion of additional funds are needed. Agriculture and agricultural research traditionally have been thought of primarily as production research but this thinking has expanded enormously in recent years to include environmental, new uses, value added products, and many other areas. Research funding has not kept pace with this proliferation, and thus the research dollar has been greatly diluted.

Modified and radical changes in our approach to agricultural production have been suggested and, in fact, demanded by some groups. Before radical methods of agriculture can be supported and dictated, the necessary research must be done. Producers, through many generations and their own experimentation, have already refined their systems, working with the knowledge and base they have, to create functional enterprises. Farmers would love to see a plant engineered such that within the capsule (seed) there would be the ability to resist drought, pests and provide their own nutritional needs for growth and development. The technology is coming. How fast it arrives and who will get it first depends on our support.

Competitive grants are the mechanism recommended for distribution of funds in the proposal. Competitive grants have a successful track record with the National Institute of Health and the National Science Foundation and the recently instituted USDA grants program. Such grants are the most profitable return on investment for discovery of new technology

germane to basic science. The four types of competitive grants recommended constitute a range that will permit individual investigator research to attract talented scientists and students into areas of agricultural research, basic multidisciplinary team grants, mission-linked multidisciplinary team grants and research strengthening grants. These four types of grants would appear to allow specific fundamental, key discovery research to occur and simultaneously permit monies to assimilate findings into research packages to take to producers.

In the real world, that of the producers, it is the entire system that must function for their success. Like a puzzle, there are certain pieces that are key to its completion. However, the discovery or location of a key piece, namely individual investigator research, does not the puzzle make. All pieces must be assimilated and fitted together, as would be accomplished by multidisciplinary team and mission-linked team grants. Without the frame (the strengthening grants) the puzzle soon becomes frayed and unravels. The recommendations made by the panel to increase the size and duration of support has good justification.

In summary, if the U.S. is to remain the premier agricultural country in the world, increased research funding is a must. Currently,the percent of our national budget committed to agricultural research compared to other countries is embarrassingly low. Our producers are eager and willing to adopt new technologies that are safe, environmentally sound and profitable. The keys need to be issued to open the locks of information waiting to be discovered. Getting the best minds into agricultural research will ensure the most effective way to fit the appropriate keys with the locks, and this procedure will be most attractive through increased funding via competitive grants.

Some would say that funding agricultural research will immediately benefit the producer, which is true. But the major ultimate benefactor will be the consumer. The assurance of an inexpensive, plentiful, safe, and nutritional crop is everyone's goal.

Our farmers are the best they have ever been, they are concerned and doing more than ever before to protect the environment and comply, although, public perception may be to the contrary. Producers are awaiting the tools to do more.

Thank you for the opportunity to testify. I will be pleased to respond to questions at the appropriate time.

STATEMENT OF THE NATIONAL COTTON COUNCIL OF AMERICA FOR THE JOINT HEARING OF THE AGRICULTURAL RESEARCH AND GENERAL LEGISLATION SUBCOMMITTEE OF THE SENATE AGRICULTURE COMMITTEE AND THE DEPARTMENT OPERATIONS, RESEARCH AND FOREIGN AGRICULTURE SUB-COMMITTEE OF THE HOUSE AGRICULTURE COMMITTEE, OCTOBER 17, 1989

The National Cotton Council is the central organization of the U.S. cotton industry, representing growers, ginners, warehousemen, cottonseed crushers, merchants, cooperatives and textile manufacturers from the Carolinas to California.

Introduction

The cotton industry has long been a proponent of a strong program of agricultural research and extension. At its inception over 50 years ago, founding fathers of the National Cotton Council recognized that development of new technology to enhance demand, improve quality, and lower production costs was paramount to U.S. cotton's survival--indeed, to the survival of U.S. agriculture.

For over a half century the Council's expressed need for a strong, adequately funded and balanced program for agricultural research and extension has been resolute. Previous testimony has been unwavering and consistent in our stated support for agricultural research. U.S. agriculture was fortunate that over 100 years ago public funding of agricultural research and education was seen as a high public priority. The passage of the Hatch Act for federal research support for states, the Smith-Lever Acts for extension, establishment of ARS, and many other actions demonstrated the foresight of our Congressional leaders.

Most people agree that there remains a national need for food, fiber, and forest products to be adequately competitive in world markets. They also agree on the desirability of a clean and safe supply of agricultural products produced in a setting conducive to maintaining environmental quality. However, what is not often understood is the essential need for science and technology to meet those national requirements. This statement briefly discusses the current situation in agriculture and develops a case for increased federal support for <u>all</u> agricultural research and education programs.

The Challenges Facing Agriculture

Competition Intense and Global

U.S. agriculture is in a tough, all-out competitive struggle for markets at home and abroad. Research and application of new technology through extension are essential to reducing production costs and losses in agriculture and to making U.S. products more competitive. U.S. producers of virtually all agricultural commodities must now compete with foreign production, which in many cases has been forced into the market through export subsidies or special actions of central governments. Other producers must vie with synthetic producers as well.

Grower Stress Increasing

As growers strive to meet their competition, they face a number of problems which are growing in importance. Many of them

can be solved by agricultural research to reduce the cost of production and improve product quality.

Resources Diminishing and Productivity is Stalled

Water supplies, for instance, have diminished and cities are demanding more of the available ground and surface water. The real and perceived need for maintaining water quality is recognized as a high national priority. Without scientific application of new techniques, soil productivity is not adequate to sustain profitability for producers. Productivity increases through fine-tuning inputs with outputs -- the only route open to the farmer for holding down costs -- are becoming far more difficult to achieve with old technologies. Fossil fuels and their derivatives -- heavily used in agriculture -- will ultimately become more scarce and expensive. Plant and animal protection chemicals are coming under more and more regulations. The cost of money is high, and restrictions on credit are growing.

Pest Problems are Increasing

Weeds, insects, diseases, nematodes and other pests in the U.S. cause losses in agricultural production of crops, livestock, forests and aquatic resources estimated at 30 percent of their sale value. These losses now total $35 billion each year. Agricultural producers spend about $10 billion each year to control pests. The evolution of existing and newly-emerging pests that are difficult to control and the potential beneficial effects of new control technologies on environmental quality are recognized as challenges which can be met through research.

Productivity Research is Key

Competition turns on three basic factors: price, quality and marketing. All three of these can best be attacked directly or indirectly through research. Unfortunately, in recent years there has been a lack of growth in real expenditures on public agricultural research, particularly at the national level.

When spending by USDA's Agricultural Research Service and Cooperative State Research Service from 1977 through 1988 is deflated by an index of dollars per scientist year, the spending level for each of the last eight years is lower than in 1977. A similar lag in funding for extension adds to the problem.

The emphasis in public research support since the mid-1960's is directly correlated with the more recent slowing of agricultural productivity. Without significant change, an even slower rate of growth is implied for the next century.

Research and Extension Serves National Interest

Several studies document the high returns to society from the public investment in agricultural research.

Dr. B. R. Eddleman of the Texas Ag Experiment Station found that the expected annual rate of return on crop and livestock research investments ranges from 30 to 50 percent with extremes of 17 to 110 percent, depending on commodity. For cotton, studies have shown a 37 percent annual rate of return.

Dr. H. E. White and associates at Virginia Polytechnic Institute calculated that one year's reduction of $100 million in the federal budget for agricultural research would be expected to cost consumers more than a hundred times that much in 20 years.

Dr. V. W. Ruttan of The University of Minnesota showed that the internal rate of return for agricultural R&D investments runs three and one-half to five times that of most public investments. The rapid transfer of research information to the farm is essential to enjoying the benefits of new technology. The Cooperative Extension Service mission of moving new findings to the farm is essential in meeting the competition.

Future Depends on Research and Education

There are two widely held but opposing views about the long-term relationship of world food, forest products, and fiber demand and supply. One view is that long-term future needs will outstrip farmers' ability to produce. The other is that supply, for the foreseeable future, has surpassed economic demand.

In either case, the necessity of expanding agricultural research is underscored.

If the first theory is correct, the obvious way to meet future food and fiber needs is to achieve more production with fewer inputs. But this simply will not happen in the absence of an adequate research effort.

If the second view is correct, U.S. agriculture will require stepped-up research and extension to maintain its competitive edge in world markets. Failure to do so inevitably will cause the decline of U.S. agriculture -- the sector which accounts for a fifth of the nation's GNP, its employment and its exports -- and therefore, the decline of the U.S. economy.

Current Priority Too Low

The number of U.S. agricultural scientists has remained static for two decades while the total in Europe, Russia, China, Japan, Canada, India and Brazil has climbed substantially. Public funding for agricultural research and extension has fallen far short of meeting the needs for a healthy future for agriculture.

Balance of Research Programs

Ongoing successful programs in agricultural research must be revised and expanded with support funds, apportioned rationally, to insure the long-time survival of American agriculture. Carefully selected and fully supported basic research programs will provide the knowledge and technology basis for applied research. Adequate bridges in the form of coordinated production-oriented research must be continued to translate and transform basic discoveries into practical uses for the agricultural producer. A strong case can be built for both types of research, and each contributes mutually to the success of a sound agricultural industry. In both cases, ARS, state experiment stations and industry have traditionally complemented the efforts of each other by planning and working together as a triumvirate to build a stronger agricultural research program.

The National Initiative for Agricultural Research

Recognizing the need for higher priority, a national initiative for agricultural research has been proposed by several research groups, most notably the Board on Agriculture of the National Research Council. The initiative is referred to as The National Initiative for Agricultural Research and calls for an increased federal funding of $500 million per year to be awarded solely to a competitive grants program.

We commend the Board of Agriculture for their comprehensive proposal and support its basic premise that significant new funding for agricultural research is necessary to insure the long term competitiveness of U.S. agriculture. While the goals of the Initiative are much in keeping with those of the cotton industry, we disagree on the proposed mechanism of funding distribution; that is, solely through competitive grants. Therefore, most of our comments will focus on Chapter 3 "Rationale for the Proposal" and in particular the rationale that all new funding shall go to competitive grants.

A Federal Initiative

We agree that primary responsibility for supporting fundamental research that benefits the nation as a whole should belong to the federal government.

A $500 Million Increase

As stated previously, the Council has long worked for increased funding for agricultural research and would support any funding increase of new money. Likewise, it is the Council's conviction that research expenditures should be used judiciously so as to maximize the effectiveness of research efforts.

Support With New Money

The Council is deeply concerned with the lack of real growth in expenditures on public research, particularly at the national level. When adjusted for inflation, the spending level has declined for almost a decade. We strongly support the statement in the proposal that without "some real growth in the USDA research budget, there can be no realistic opportunity to broaden the scope of science contributing to agricultural, food, and environmental research".

We also appreciate the statement that the proposal is against reallocation within the USDA research budget. For many years, most higher priority research has been funded by shift in funds. In spite of excellent planning efforts at all levels, limits on gains through redirecting current efforts have been met. There are few programs left which can be redirected without adversely affecting other important efforts. Unfortunately we have seen important public research programs become ineffective and eventually lost due to cannibalization of other efforts. The fact is that the core programs -- ARS and CSRS -- are drastically underfunded and are suffering from inadequate support. Pure competitive grants do not address the fundamental problem which limits the effectiveness of correct programs.

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The Role of Competitive Grants

While we strongly support a major new initiative for agricultural research, the competitive grants approach should not be the sole mechanism for awarding the new monies, nor should it be the major one. The cotton industry's position adopted by Council delegates is that any major new initiative should be in concert with strengthening core programs to states and ARS. The proposal asserts that "The only way to give full and timely application to the scientific and engineering progress that will be made through the competitive grants program is by maintaining and strengthening the existing research and education programs, including formula-funded programs". We agree wholeheartedly; but the proposal does not call for strengthening existing programs of ARS and Hatch.

In our assessment, the current programs of formula funding to states and appropriations to the ARS have proved to be highly efficient. Critics of the current agricultural research system infer that ARS and Hatch funds do not address high priority national problems. We disagree and argue that these do indeed address critical regional and national needs and because of their more stable base of funding, program efforts can be shifted most effectively according to highest priorities.

Under the current system, scientists and engineers, given proper direction, can devote nearly full time and total energies toward accomplishing research objectives. Thus, a minimum of valued scientific efforts are lost in the pursuit of grants. The proposal recognizes the risk of inefficiency in preparing grants proposals but concludes the loss is necessary to ensure the highest quality of science. We are not convinced that we will be getting a higher quality of science nor of the wisdom of the tradeoffs.

Often, grant-seeking scientists, especially from non-agricultural institutions, are naive in regard to specific organisms to be investigated. A significant portion of a grant's duration may be spent building a base of understanding for the investigator about the commodity, pest or other organism/system under investigation. We agree that new scientific talent must be brought into agriculture, but talent cannot efficiently enter and exit the agricultural research system at the whim of a temporary grant. By comparison, experienced scientists having earned valuable "front-line" knowledge can be highly efficient with virtually no startup time loss.

The proposal argues for the merits of peer review. However, peer review is not new to the core programs of ARS and CSRS. Long range planning and program review efforts for assuring the significance of scientific and engineering efforts have served the agricultural research community well. To name a few, the Experiment Station Committee on Organization and Policy developed a consensus of a strategic plan for states' research. The Agricultural Research Service has developed and is implementing management plans for redirecting programs within the federal agency. The National Agricultural Research Committee of the Joint Council of Food and Agricultural Sciences brings together the agricultural research community at the national level. And commodity groups develop their own research priority plans and make them available to public and private research institutions.

For example, the cotton industry recently completed efforts to identify and focus on high-priority researchable problems in hopes that existing funds will be used most effectively.

The proposal comes at a time in which current ARS programs barely have sufficient funds for salaries with very little money available for operations. By placing all new research funds into competitive grants without restoring current efforts to healthier levels will continue to force the core programs of ARS/CSRS to shrink. We believe the muscle of these programs has already been cut to the point of decreasing effectiveness and would propose that the same argument used to support increases in competitive grants should be used to support increases in the core programs. For a viable competitive grants program, we must maintain a strong core/base program, but first it must be restored to a healthy condition.

As stated earlier, we appreciate the clear statement that the proposal is against reallocation within the USDA research budget. However, we disagree with proposal's definition of balance. We would prefer a strong statement calling for allocation of additional new dollars for ARS and CSRS to states along with an increase in competitive grants. We would be pleased to see initiatives of which new funds were equally divided among ARS, Hatch and competitive grants. We would prefer a balanced growth approach.

We also feel that Congressional participation in setting the agricultural research and extension agenda is appropriate and should be sought. Members of Congress and their linkage to producers and consumers is a valued resource which should be maximized.

Conclusion

We appreciate the opportunity to provide testimony to this joint committee. In summary, we believe the current agricultural research system in the U.S. is the best in the world and it is in the public's best interest to strengthen it. Additional research funds are urgently needed to assure that agriculture maintains a competitive edge while maintaining profits for the producer. We believe this can be done while assuring high quality supply of food, fiber, and other products which are produced in an environmentally sound manner.

There is no argument as to whether a major initiative is needed. The only disagreement is on what funding mechanism will be most effective and efficient. While the proposal states that this competitive grants program is not to be substituted for existing ARS/CSRS-formula or other non-competitive grants funds, the proposal is lacking because it does not call for increases in these non-competitive grants programs. The proposal's failure to explicitly call for strengthening core programs is of very serious concern, especially in view of the fact that history has proven that these programs do not receive the highest priority. Assurance of non-substitution nor reallocation is not enough.

Thank you for the opportunity to present our views. We will be pleased to provide additional input on any questions you might have.

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TESTIMONY

on behalf of

National Cattlemen's Association

before the

Joint Hearing of the
Subcommittee on Agricultural Research and General Legislation
of the
Senate Agriculture, Nutrition and Forestry Committee

and

Subcommittee on Department Operations, Research
and Foreign Agriculture
of the
House Agriculture Committee

October 17, 1989

regarding

A National Academy Science Report on Investment in Agriculture

by

James Martin
Chairman of the Research and Education Committee
of the National Cattlemen's Association

- -

The National Cattlemen's Association is the national spokesman for all segments of the beef cattle industry--including cattle breeders, producers and feeders. The NCA represents approximately 240,000 cattlemen. Membership includes individual members as well as 47 affiliated state cattle associations and 26 national breed associations.

Good afternoon, Mr. Chairman and members of the Committee. I am Jim Martin, a cattle producer from Indiana. I serve as chairman of the Research and Education Committee of the National Cattlemen's Association (NCA). I am testifying today on behalf of my colleagues in the cattle business as represented by NCA.

NCA is very pleased that the subject of agricultural research has been elevated to the point that this hearing has been called. We wish to thank both the Chairman and the Committee for the leadership being shown here today.

Each and every year, we have been called upon by the research community -- land grant universities and others -- to support increases in agricultural research funding. Without fail, the requests for increases have been across-the-board increases for nearly every line item in the budget. We haven't been enthusiastic in our support -- mostly because there was no evidence of a new commitment on the part of the research community. It was simply more of the same.

Production agriculture, and the consuming public, have benefitted greatly from agricultural research, and we want to see funding continue for this effort. However, before we could support a new funding initiative, we wanted to see a renewed commitment on the part of the research community -- some creativity, some new thinking. We believe that such a commitment is embodied in the new $500 Million Initiative being discussed here, and we are supportive of it. Finally, a bold and ambitious initiative has been launched, and we are pleased to see it and proud to support it.

In our judgement, any new funds for agricultural research should be in the form of competitive grants -- a feature of the $500 Million Initiative. Current formula funding keeps the doors open at our land-grant institutions. Those funds maintain a core group of scientists and educators that are fundamentally important for our future in a high-tech world. Beyond this, additional funding should be awarded competitively to the very best research efforts. Yes, this probably means that some institutions will get a lot more money than others, but that's the way the real world works. We simply can't support this initiative unless it is designed to focus on the highest priority problems and opportunities facing agriculture. We can't support an across-the-board enrichment of every institution now receiving Hatch funds, regardless of the relevance and importance of their research efforts. We believe the same number of dollars will solve a lot more problems, and exploit a lot more opportunities, if researchers have to put their best foot forward and compete for funding beyond the base level provided by formula funds.

In the same sense that American Agriculture must compete in the world market on the basis of efficiency and quality, our researchers should actively compete for funds within our own economy on the basis of relevance and ingenuity. Without this structure, our future as a viable competitor in the world market is limited indeed.

Questions have been raised as to whether the agricultural research community could effectively use $500 million if it suddenly became available. I don't know the answer to that question, but I certainly have doubts that it could. I have no doubt that it could gear up to use $500 million very effectively, but it may take a few years. That's okay. As the old saying goes, the longest journey begins with a single step. We believe it is important to take the first step now and begin breathing new life into our agricultural research system.

NATIONAL RESEARCH COUNCIL
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BOARD ON AGRICULTURE

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October 17, 1989

Congressman George E. Brown, Jr.
2256 Rayburn House Office Building
Washington, DC 20515-0536

Senator Thomas A. Daschle
317 Senate Hart Office Building
Washington, DC 20510-4103

Dear Congressman Brown and Senator Dashchle:

Thank you for the invitation to present testimony concerning "Investing in Research," a just-published report of the Board on Agriculture, to a joint hearing on October 17, 1989 of the Department Operations, Research, and Foreign Agriculture Subcommittee of the House Agriculture Committee and the Agriculture Research and General Legislation Subcommittee of the Senate Agriculture, Nutrition, and Forestry Committee. I have tried assiduously to participate personally in the hearing, but very long-standing obligatory responsibilities to the University of California, Davis--of which I am the Chancellor--have, finally, precluded my participation. Two members of the Board on Agriculture--Dr. Robert Thompson (Purdue University) and Dr. Robert Goodman (Calgene, Inc.) will present testimony in person.

Please incorporate this letter into the record of the hearing.

Several major, vexing problems confront U.S. agriculture today. Among these are increasing our competitiveness both internationally and nationally, ensuring the safety and nutritive quality of our foods in the face of rapidly changing living patterns and public concerns, and substantially increasing natural resources stewardship. The Board has concluded that these and related concerns are best met within an expanded concept of agriculture, which we have termed the "agricultural, food, and environmental system."

Meeting these challenges requires an adequate agricultural, food, and environmental research system, as well. The state agricultural experiment stations (SAES) and their associated colleges of agriculture and the USDA's Agricultural Research Service (ARS)--two key components of the research system --generally perform well and at high capacity. Steady and thoughtful direction of those funds by the relevant research leaders within those components keeps them as current with the needs and opportunities as possible.

However, another key component of the research system--the competitive grants program of the USDA--is not adequate for the key role it must play in sustaining the agricultural, food, and environmental system.

The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering to serve government and other organizations

The Board on Agriculture, in its studies culminating in "Investing in Research," concluded that a much expanded competitive grants program is essential if there is to be continued vitality of the U.S. agricultural, food, and environmental system. The Board believes that the current competitive grants performs admirably well, to the extent funds are available. But, the Board concludes that the funds available are wholly inadequate to the problem (and research) needs.

To deal with this, and closely related issues, the Board reached a number of conclusions and presented them in the report as recommendations:

- Funding for the competitive grants program in USDA should be increased by $500 million.

- The scope of the competitive grants program should be expanded to address all of agriculture, and the Board set forth six program areas to do this. Further, scholars in all scientific disciplines relevant to problems in those areas should be eligible and encouraged to participate.

- Grants should emphasize fundamental studies so as to provide the nationally-relevant information to fuel further knowledge and applications. In addition, grants should include multidisciplinary studies to accommodate the multifaceted problems so characteristic of both fundamental and more mission-oriented problems. Further, and very importantly, there should be research strengthening grants, to both institutions as program grants and to individuals as fellowship, to ensure continued strength of the nation's agricultural research infrastructure.

- Grants should be of sufficient size and duration to conduct research adequately, rather than be of too-small size as at present.

- Funds in current ARS and Cooperative State Research Service programs should remain in those programs. They should not be redirected to this expanded competitive grants program.

- Although views may differ on the way the expanded program should be managed, it is the Board's view that it should be administered by the USDA through an Office of Competitive Grants of administrative status equal to that of the ARS and the Cooperative State Research Service.

A number of advantages will ensue for the nation--and our agricultural, food, and environmental system--if this program is established. First, agriculture will begin to have a competitive grants program of size and stature fitting to it, just as medicine has its highly successful NIH program. Second, there will be sufficient funding, size and duration of grants, and program scope to begin to attract and retain the long-term attention of scientists throughout the nation's research sector. Third, because of that, agriculture will have the opportunity to involve all of the nation's

scientists, to add to and extend the work of those in our land-grant colleges of agriculture and in the ARS. Fourth, major new grant programs will be available to deal adequately with the multifaceted nature of the science and problems of agriculture and with ensuring the nation's agricultural research system.

In sum, it is my view--as chairman of the Board on Agriculture, as a former director of an agricultural experiment station (at Cornell University), and as a principal author of the report--that an expanded competitive grants program of the size, scope, and type described in "Investing in Research" is very much needed to achieve the nation's short- and long-term interests, that the $500 million expansion should be funded now even during the duress of balancing deficit reduction with essential program needs, and that the expanded program will provide handsome benefits and dividends to the agricultural, food, and environmental system--and to the nation's scientific capacities overall.

I will be pleased to work with the subcommittees and other committees of the House and Senate to the fullest extent to ensure that the report and its recommendations are fully understood and implemented.

Thank you for providing this opportunity to comment.

Sincerely,

Theodore L. Hullar

Theodore L. Hullar
Chairman

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